INTRODUCTION

TO A HISTORY OF

IRONMAKING AND COAL MINING

IN PENNSYLVANIA.

CONTRIBUTED TO THE FINAL REPORT OF THE PENNSYLVANIA BOARD OF CENTENNIAL MANAGERS.

BY

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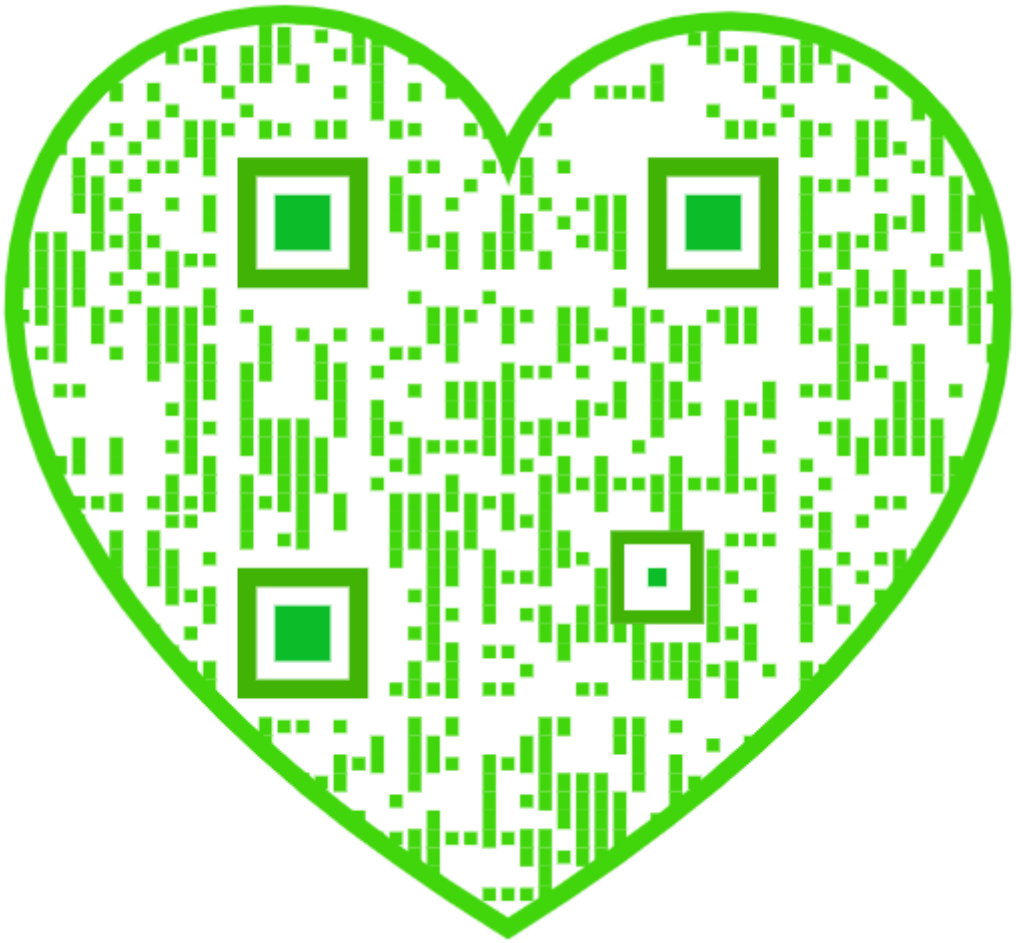

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PREFACE.

THE following chapters were written during the summer of 1877, at the request of the Pennsylvania Board of Centennial Managers, to accompany their final report to the Pennsylvania Legislature, and are believed to possess sufficient value to justify their publication in a form which will make them accessible to the general reader. They were written amid the pressure of other duties, and it is possible that the critical reader will detect some errors of statement and some omissions of important facts which in his charity he may concede would not have occurred if the author had been a gentleman of leisure, as every true historian ought to be, intent on doing one piece of work at a time and doing it well. I am, however, not conscious of any lack of enthusiasm or industry in the performance of a really difficult and laborious task.

That there may be no misunderstanding, I wish distinctly to impress upon the mind of the reader the fact that I have not attempted to write a complete history of ironmaking and coal mining in Pennsylvania, but have assumed only to write such an introduction to their history as will contain a record of the principal events which mark the beginning of these two great industries of our State, and mark, also, the leading events in their subsequent development. Beginning with their beginning, I end with the progress they had made down to 1876, but only glance at the great gap between. Otherwise stated, the scope of the following pages embraces a statement of the first enterprises in ironmaking and coal mining in Pennsylvania, a reference to significant periods of their development, and a summary of ultimate results. Greater amplitude and detail could only have been possible by completely changing the plan upon which the two essays had been projected. I have undertaken to preserve only that part of the history of our iron and coal industries that is of most value and is in most danger of being lost.

To those who would have been gratified to see in this volume a description of existing ironworks in Pennsylvania, it is proper that we should say that the American Iron and Steel Association published in 1876 a complete list of all such enterprises in the United States, which list is now being revised for publication in the spring of the present year.

In the preparation of the chapters which follow I have consulted all accessible printed sources of information which were deemed authentic, and, in addition, I have personally or by letter communicated with many persons who were likely to possess information concerning our early ironmaking and coal-mining enterprises. Upon many of the subjects treated of in connection with the history of early ironmaking in Pennsylvania, as, for instance, the first iron rails made in the United States, there was absolutely no literature to consult, and great difficulty was experienced in obtaining reliable facts from living ironmasters, family records, or other private sources.

I have been greatly aided by the polite and sympathetic attention of the gentlemen in charge of the library of the Historical Society of Pennsylvania, who have afforded me every desired facility for the examination of historical data contained in colonial records, old maps, local histories, and biographical sketches.

I have freely consulted in the library of the American Iron and Steel Association such standard historical and statistical works as Charles E. Smith's *Statistics of Iron Manufacture in Pennsylvania*, (1850); J. P. Lesley's *Iron Manufacturer's Guide*, (1857); Joseph Scott's *Geographical Description of Pennsylvania*, (1806); Sherman Day's *Historical Collections of the State of Pennsylvania*, (1843); Thomas F. Gordon's *Gazetteer of the State of Pennsylvania*, (1832); Dr. William H. Egle's *Illustrated History of the Commonwealth of Pennsylvania*, (1876); Dr. J. Leander Bishop's *History of American Manufactures*, (1861); J. H. Alexander's *Report on the Manufacture of Iron*, (1840); Harry Scrivenor's *Comprehensive History of the Iron Trade*, (London, 1841); Daddow & Bannan's *Coal, Iron, and Oil*, (1866); Walter R. Johnson's *Notes on the Use of Anthracite*, (1841); etc., etc. I have quoted freely from the Annual Reports of the Secretary of the American Iron and Steel Association for 1876 and 1877. Mr. Robert W. Hunt's paper on the "History of the Bessemer Manufacture in America," and the paper of my deceased friend, Mr. William Firmstone, entitled a "Sketch of Early Anthracite Furnaces," both papers contained in the *Transactions of the American Institute of Mining Engineers*, (1875 to 1877), have been carefully studied. I have also examined Hon. Abram S. Hewitt's lecture on the *Statistics and Geography of the Production of Iron*, (1856); B. F. French's *History of the Rise and Progress of the Iron Trade of the United States*, (1858); and John B. Pearse's *Concise History of the Iron Manufacture of the American Colonies and of Pennsylvania*, (1876). Mrs. Isabella James's *Memorial of Thomas Potts, Junior*, was of great service to me, because of the reliable documentary references to colonial ironmaking which are contained in it. I am also under obligations to this lady for some suggestions of value in connection with the same period of our iron history.

Although it is impossible in a brief preface to mention the names of all the friends who have aided me, verbally or in writing, in obtaining information, there would seem to be a special propriety in mentioning the fact that in my search for reliable data I have not limited my inquiries to our own country, but have been honored by a correspondence with two distinguished Englishmen, Mr. R. F. Mushet, concerning his share in perfecting the Bessemer Process, and Dr. C. W. Siemens, concerning his invention of the Gas Furnace and Direct Process. I name these gentlemen to show to the reader that wherever it has been possible I have gone to the fountain-head for information.

The publication of the report of the Pennsylvania Board of Centennial Managers having been delayed until February, 1878, owing mainly to the illness of their Secretary, Alexander C. Mullin, Esq., as a matter of propriety the contributions to that report which are contained in this volume could not be published until now, although written several months ago.

JAMES M. SWANK.

OFFICE OF THE AMERICAN IRON AND STEEL ASSOCIATION,
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EARLY
IRONMAKING IN PENNSYLVANIA.

THE object of the following sketch is to record, in chronological order and without violence to geographical requirements, the first steps that were taken in Pennsylvania to make iron, and to show the extent of the iron interest of the State at the close of the first century of our national existence. We shall endeavor, first, to record the beginning of the iron industry in each of the iron-producing sections of the State; second, to note in detail the introduction of those radical changes in the business of iron and steel making with which Pennsylvania has been prominently identified; and, third, to present such statistics of the past and present condition of the iron industry of the State as seem to us to be worthy of preservation. It has not been our purpose to preserve a list of all the iron enterprises that have existed in the State, if that were possible; nor to boast of the metallurgical achievements of Pennsylvania ironmasters and their workmen; nor to seek the aid of the geologist and the chemist in describing the iron ores of the State and the conditions under which they are found. We leave these features of the history of ironmaking in Pennsylvania to other hands. The publication of this sketch is believed to be amply justified by the revived interest in our national annals which the Centennial itself has created, and by the great prominence of Pennsylvania among the iron-manufacturing States of the Union. In the development of the iron industry of the nation Pennsylvania has been in many respects, as will hereafter appear, the pioneer of all her sisters, while she has long been their honored leader in contributing to the quantity and variety of American iron products.

Beginning of the Iron Industry in the United States.—In 1619 the London Company sent workmen to Virginia "to set up three ironworks." The enterprise was at once undertaken on Falling creek, a branch of the James river, and not far from Jamestown. Here iron was undoubtedly made in 1620 and 1621, but on the 22d of March, 1622, most of the workmen were cut off by the Indians and the works were destroyed. No other attempt to make iron in Virginia seems to have been made for about a hundred years. The next attempt to make iron in the colonies was in the province of Massachusetts Bay. A furnace was erected in 1643 on the western bank of the Saugus river, at Lynn, by a company of which John Winthrop, Jr., was the leading spirit. In 1651 a forge had been added to the furnace. The first vessel cast in New England was a small iron pot, cast by Joseph Jenks, Sr., at Lynn, probably in 1644. In 1648 a forge was established at Braintree by Winthrop's company, and in 1652 one was established at Raynham by two brothers named Leonard, at least one of whom had been employed at Lynn. In 1656 the first ironworks in Connecticut seem to have been established at New Haven by Captain Thomas Clarke. About 1734 a forge was erected by Thomas Lamb at Lime Rock, in the Salisbury district of Connecticut. In 1748 a forge was erected at Lakeville, in the same district, and in 1762 the first blast furnace in the State was built at this place by Ethan Allen of Ticonderoga fame, John Haseltine, and Samuel Forbes. Rhode Island made iron soon after its settlement in 1636. In 1675 a forge at Pawtucket, erected by Joseph Jenks, Jr., was destroyed by the Indians, as were also other ironworks and infant enterprises. Henry Leonard, one of the first ironworkers at Lynn, removed to Shrewsbury, New Jersey, soon after 1664, and there set up probably the first forge in that province. It is stated that in 1682 "a smelting furnace and forge were already set up" in New Jersey, and it is supposed that they were built at Shrewsbury, and were then owned by Colonel Morris. In 1685 Thomas Budd wrote that there was but one ironwork in New Jersey, and that this was located in Monmouth county. Shrewsbury is in this county. Pennsylvania first experimented in making iron about 1692, but the industry was not established until 1716. No iron enterprises were established in New York until after 1734. It is probable that the first ironwork in the State was erected about 1740 by Philip Livingston, on Ancram creek, in Columbia county. The iron industry was revived in Virginia about 1715, Colonel Alexander Spotswood building two

furnaces, one of which was a smelting furnace at Fredericksburg, on the Rappahannock river, and the other was a very complete air furnace at Massaponax, fifteen miles distant, on the same river. In 1732 there were four furnaces on the Rappahannock, in one of which, Principio furnace, Augustine Washington, the father of George Washington, was largely interested, the ore used in it being supplied by him from his plantation, two miles distant. His mother's family, the Balls, were also interested in the same or in a neighboring iron enterprise. Augustine Washington's plantation was at Bridge's creek, in Stafford county, on the east side of the Rappahannock. About the same year that the iron industry was revived in Virginia the manufacture of iron was commenced in Maryland. Principio forge, in Cecil county, was among the first iron enterprises in the State, if it was not the very first. It was owned by the same company that owned Principio furnace in Virginia, which State partly supplied it with pig iron. The Carolinas also made iron about 1715. North Carolina is entitled to the honor of having first given to Europeans the knowledge that iron ore existed in the American colonies. The discovery was made by the expedition fitted out by Sir Walter Raleigh in 1585.

Beginning of the Iron Industry in Pennsylvania.—Pennsylvania was one of the last of the colonies to begin the development of its iron resources, but it was also one of the last of the colonies to receive permanent settlers. The Swedes and Dutch, who were its first settlers, holding almost entire possession of its territory down to the granting of Penn's charter in 1681, probably made no iron within its limits, although there is a tradition that the Swedes made iron at Tinicum in Governor Printz's time, from 1643 to 1653. William Penn sailed up the Delaware in the *Welcome* in 1682, and in a letter written in 1683 he mentions "mineral of copper and iron in divers places" as having been found in his province. In other letters he expresses the wish that the iron and other mineral resources of the province may be developed. In 1692 we find the first mention of iron actually having been made in the province. It is contained in a metrical composition which is preserved in the library of the Historical Society of Pennsylvania, the title of which is as follows: *A Short Description of Pennsylvania:* "Or a Relation what things are Known, Enjoyed, and like to be Discovered in the said Province. Issued as a token of good will . . . of England. By Richard Frame. Printed

and sold by William Bradford in Philadelphia, 1692." Frame describes in his epic the wild and tame beasts, and the fowl, fish, cereals, fruits, berries, nuts, etc., which are found in the province, and in regard to iron says that at "a certain place . . . about some forty pound" had then been made. This iron was probably made in a common smith's fire.

In 1698 *An Historical and Geographical Account of the Province and Country of Pennsylvania and of West New Jersey in America*, . . "by Gabriel Thomas, who resided there about Fifteen Years," was published at London, in which mention is made of the mineral productions of these colonies. Alluding to Pennsylvania, he says: "There is also ironstone or ore, lately found, which far exceeds that in England, being richer and less drossy. Some preparations have been made to carry on an ironwork." From this statement by Mr. Thomas we infer that the experiment alluded to by Mr. Frame, which resulted in the production of forty pounds of iron as early as 1692, did not lead at the time to the establishment of an "ironwork." Nor can we learn that the "preparations" mentioned by Mr. Thomas led to any immediate practical results. In 1702 James Logan wrote to William Penn as follows: "I have spoke to the chief of those concerned in the iron mines, but they seem careless, never having had a meeting since thy departure; their answer is that they have not yet found any considerable vein." Bishop, in his *History of American Manufactures*, quotes Oldmixon as mentioning in 1708 a deposit of iron ore called "iron hill" in New Castle county, then in Pennsylvania, between the Brandywine and Christiana; and Mrs. James, in her *Memorial of Thomas Potts, Junior*, says that on the 24th of September, 1717, Sir William Keith, Governor of Pennsylvania, "wrote to the Board of Trade in London that he had found great plenty of iron ore in Pennsylvania."

Two years before the death of Penn in 1718 the first ironworks were established in Pennsylvania. The event is briefly described in one of Jonathan Dickinson's letters, written in 1717, and quoted by Mrs. James: "This last summer one Thomas Rutter, a smith, who lives not far from Germantown, hath removed further up in the country, and of his own strength hath set upon making iron. Such it proves to be, as is highly set by by all the smiths here, who say that the best of Sweed's iron doth not exceed it; and we have accounts of others that are going on with iron works." Rutter's enterprise was a bloomary forge, called Pool forge, the exact loca-

tion of which is uncertain, but it was on Manatawny creek, and probably about three miles above Pottstown. Mrs. James visited the spot it is supposed to have occupied, "and could see some remains of the dam, and an excavation in the bank where buildings once stood." Another Pool forge is known to have existed farther up the stream, probably built after the first one was abandoned. Pool forge was attacked by the Indians in 1728, who were repulsed. Bishop says: "A forge is mentioned in March, 1719–20, at Manatawny, then in Philadelphia, but now in Berks or Montgomery county." This reference is undoubtedly to Pool forge.

In Day's *Historical Collections* mention is made by a historian of Chester county of Samuel Nutt, who built a forge called Coventry, in the northern part of Chester county, which "went into operation about the year 1720," and made "the first iron" manufactured in Pennsylvania. Another historian of Chester county contributes to Egle's *History of Pennsylvania* the information that Samuel Nutt did not arrive in this country until 1714. "He took up land, on French creek, in 1717, and about that time built a forge there. A letter written by him in 1720 mentions an intention of erecting another forge that fall." Mrs. James states that Nutt purchased 800 acres of land at Coventry in October, 1718. She claims that Rutter removed in 1714 from Germantown "forty miles up the Schuylkill, . . . in order to work the iron mines of the Manatawny region." In her *Memorial* she gives a *verbatim* copy of the original patent of William Penn to Thomas Rutter for 300 acres of land in Manatawny, dated February 12, 1714–15. Dickinson says positively that Rutter made iron in 1716. Nutt probably made iron at Coventry forge in 1718. Bishop refers to a letter written by Dickinson in July, 1718, stating that "the expectations from the ironworks forty miles up Schuylkill are very great." In April, 1719, Dickinson again wrote: "Our iron promises well. What hath been sent over to England hath been greatly approved. Our smiths work up all they make, and it is as good as the best Swedish iron." Dickinson probably meant Nutt's forge as well as Rutter's. The following obituary notice in the *Pennsylvania Gazette*, published at Philadelphia, dated March 5 to March 13, 1729–30, ought to be conclusive proof of the priority of Thomas Rutter's enterprise: "March 13. On Sunday night last died here Thomas Rutter, Senior, of a short illness. He was the first that erected an ironwork in Pennsylvania." Both Rutter and Nutt were Englishmen, and were men of means and great enterprise.

After they had removed up the Schuylkill, Nutt married Mrs. Anna Savage, the widowed daughter of Thomas Rutter. Her first husband, Samuel Savage, had accompanied her father when he went up the Schuylkill to make iron.

Bishop says that "Sir William Keith had iron works in New Castle county, Delaware, erected previous to 1730, and probably during his administration from 1717 to 1726." This enterprise consisted of a furnace and forge, which were located on Christiana creek, and were built about 1725. At that time Delaware was embraced within the limits of Penn's province, and it was here that Keith had discovered the "great plenty of iron ore in Pennsylvania" of which he wrote to the London Board of Trade. There is authority for the statement that the furnace was abandoned before 1730, and that another furnace was erected which never went into blast. Iron was, however, made on the Christiana in bloomaries for several years after 1730.

In Watson's *Annals* the statement is made that "the first built furnace of Pennsylvania was that of Colebrooke Dale, (Berks Co.,) built in 1720 by James Lewis and Anthony Morris, of Philadelphia." This statement is supported by the fact that Thomas Potts, Jr., was a resident of Manatawny as early as 1720, where he was acting in 1725 as the agent of his rich relative, Anthony Morris, one of the alleged builders of the furnace. It is further strengthened by the fact that Anthony Morris and Thomas Potts were in 1731 part owners of Colebrookdale furnace, and also part owners when the furnace was torn down and rebuilt by a company in 1734. It is corroborated as to the date by information communicated to us in a letter from Mrs. James, in which she says: "I have a large calf-bound folio ledger of nearly 200 folios of Colebrookdale furnace, marked 'B.' The first date is August, 1728, but there are several pages referring to the first ledger, one of them in 1726. . . . Mention is constantly made . . . of sending 'piggs' to Pool forge, proving that Pool was then in full blast. . . . 'A' would seem to be a large volume from reference to the folios," and therefore to have covered the operations of a number of years. Mrs. James thinks that it is lost. If it could be found it would doubtless show that Colebrookdale furnace was built in 1720, or a year or two earlier. Mrs. James is of the opinion that Thomas Rutter built the furnace, but she also writes to us that on the title-page of ledger "B," above referred to, the name of Thomas Potts is written in connection with the year 1728. This was *before* Thomas

Rutter's death on March 8, 1730. In his will, dated November 27, 1728, he does not give the name of any of his iron possessions. The opinion is fairly warranted that Colebrookdale furnace was built by a company, of which Thomas Rutter, Anthony Morris, James Lewis, and Thomas Potts were among the members, with Thomas Potts as their agent—Thomas Rutter being the principal owner. This opinion derives plausibility from the following extracts from Thomas Rutter's will, on file in the office of the Register of Wills in Philadelphia, and which we have examined.

"I give and bequeath unto my son Thomas Rutter one-third part of y^e^ one hundred acres of land leased to a furnace company, with y^e^ one-third part of y^e^ said furnace, iron ore, or other appurtenances to y^e^ said one hundred acres of land. . . . I give and bequeath unto my son Joseph Rutter the one-third part of the furnace, iron ore, and other its appurtenances, with the one-third part of one hundred acres of land leased to y^e^ furnace company, and also two-thirds of my other land adjoining to y^e^ furnace land; also two-third parts of y^e^ forge, and of y^e^ hundred acres of land whereon y^e^ forge stands."

The furnace here referred to was unquestionably Colebrookdale furnace, and the forge was Pool forge. In the inventory filed with the will, and dated "March y^e^ 18th, 1729–30," appraisement is made of "two-thirds of the furnace and iron ore and of one hundred acres of land," etc., corresponding to the words of the will in its reference to the furnace. The truth of history will not be violated if we award ungrudgingly to Thomas Rutter the honor of having erected the first blast furnace, as well as the first forge, in Pennsylvania.

Colebrookdale furnace was located in Berks county, on Ironstone creek, a branch of the Manatawny. It stood about eight miles north of the mouth of the Manatawny, and three-fourths of a mile west of the present town of Boyertown, and about two hundred yards from the Colebrookdale Railroad. Plenty of cinder marks the exact site. A large grist and saw mill stands about one hundred feet distant. It would seem that friendly Indians were employed at the furnace, as "Indian John" and "Margalitha" are found in the list of workmen about 1728. In Nicholas Scull's map of Pennsylvania, published in 1759, Colebrookdale furnace is mentioned, and in a list of ironworks existing in Pennsylvania in 1789, and published by Mrs. James, it is again mentioned, although we infer that it was not then active. We have not found the furnace mentioned at any later period. A stove-plate cast at this furnace in 1768, and so inscribed, was exhibited at the Philadelphia

Exhibition. In 1731 pig iron sold at Colebrookdale furnace "in large quantities." The name of this furnace was sometimes written Colebrook. It is an interesting coincidence that the first furnace in England to cast pots, kettles, and other hollow ware by the use of sand moulds was Abraham Darby's Colebrookdale furnace in Shropshire, which he leased in 1709. It was a small charcoal furnace, and had been in existence for a century. Darby converted it into a coke furnace. He died in 1717. As he was a cotemporary pioneer in the iron business, and a Friend or Quaker, as were most of the pioneer ironmasters of Pennsylvania, it is easy to imagine that Penn's colonists should have called their first furnace after Colebrookdale furnace in Shropshire.

After the death of Thomas Rutter, in 1730, Thomas Potts, Jr., became the principal owner and manager of the ironworks on the Manatawny, carrying them on with ability and success for many years. He was the progenitor of many noted Pennsylvania ironmasters of the same name in the last and present centuries. Several of his sons intermarried with the heirs of Thomas Rutter and Samuel Nutt. He died in January, 1752, aged seventy-two years. In his will, dated 1747, he leaves his "two-thirds of Colebrookdale furnace and iron mines" to his son Thomas. Tradition says that he was born in Wales.

Soon after Nutt had built his forge at Coventry it is believed that he built a furnace on French creek, called "Redding." Mrs. James places the date of its erection at about 1720. It is probable that it was the second furnace in the State, Colebrookdale being the first. Samuel Nutt died in 1737.

In Samuel Nutt's will, dated September 25, 1737, he bequeaths to his wife one-half of his right to a furnace and forge, and to his nephew and step-son-in-law, Samuel Nutt, Jr., and his wife the remaining half of such right. The furnace referred to was undoubtedly Reading, and the forge was Coventry, in the ownership of each of which William Branson was probably an equal partner.

Second Stage in the Development of the Iron Industry of Pennsylvania.—In 1728 there were four furnaces in blast in Pennsylvania, one of which undoubtedly was Colebrookdale. Another was Durham, in Bucks county, where there was also a forge about the same time. The others were probably Sir William Keith's, on Christiana creek, and Samuel Nutt's Redding furnace on French creek. Durham furnace was built in 1727, but its first blast did not take

place until the spring of 1728. It was built by a company of fourteen persons, of which company James Logan, who was Penn's secretary, was a member. In November, 1728, James Logan shipped three tons of Durham pig iron to England. In the consolidated exhibit of the ironworks of the Lehigh valley at the Philadelphia Exhibition in 1876, the keystone of the Durham furnace, bearing date 1727, was an interesting feature. In 1728–9 Pennsylvania exported 274 tons of pig iron to the mother country.

There is reason to believe that as early as 1734 there were two Durham furnaces. In Scull's map of Pennsylvania (1759) an old and a new furnace and a forge at Durham are distinctly marked. In 1770 there were two furnaces and two forges at Durham. There were at one time three forges on Durham creek. The first furnace was torn down in 1819, and Long's grist-mill was built on its site. The father of the celebrated Daniel Morgan of the Revolution was a charcoal-burner at Durham ironworks. As late as 1780 there were negro slaves employed at Durham, twelve of whom in that year escaped to the British lines. Much of the iron made at Durham was taken to Philadelphia in boats fashioned somewhat as an Indian canoe, and first built at Durham; hence the term, afterwards in common use, "Durham boats." These boats were about sixty feet long by eight feet wide. They were sometimes propelled by sails, but most frequently with poles in the hands of men who walked upon footways on each side of the boat. The Durham boat closely resembled the more modern keel-boat.

Iron was made within the ancient limits of Lancaster county at a very early day. Day says the first ironworks in the county are supposed to have been built by a person named Kurtz, in 1726, and that the enterprising family of Grubbs commenced operations in 1728. We have traced the authority for this statement to *Hazard's Register*, volume 8, where there is a fragmentary quotation from the *Lancaster Miscellany* of information contributed by Redmond Conyngham. From another source we learn that Kurtz was an Amish Mennonite. He probably built a bloomary forge. In Egle's *History of Pennsylvania* it is stated that Kurtz's works were on Octorara creek, and that it is possible they were in Maryland, and not in Lancaster county. Of the Grubbs we shall speak hereafter. McCall's forge, on Manatawny creek, afterwards Glasgow forge, was built about 1725 by Anthony Morris and George McCall. Spring forge, at Spring Mill, owned by Anthony Morris, was running in 1729, as was Pool forge. These forges were supplied

with pig iron from Colebrookdale furnace. Green Lane forge, on Perkiomen creek, twenty miles north of Norristown, was built in 1733 by Thomas Mayberry. The workmen employed here were at one time chiefly negro slaves. This forge was supplied with pig iron from Durham furnace before 1747. Rev. George Michael Weiss is said to have owned it before 1763. Glasgow and Green Lane forges were in operation down to the middle of the present century. Redding furnace, on French creek, which was undoubtedly the second of the name, was built by Samuel Nutt and William Branson in 1735–6; Warwick furnace, also on French creek, by Samuel Nutt's widow, in 1737; Mount Pleasant furnace, on Perkiomen creek, thirteen miles above Pottstown, by Thomas Potts, Jr., in 1738; Cornwall furnace, in Lebanon county, by Peter Grubb, in 1742; Elizabeth furnace, in Lancaster county, about 1750. Mount Pleasant forge, built after the furnace, was in operation as late as 1856. Elizabeth furnace continued in operation until 1856, about one hundred years, when it was abandoned by its owner, Hon. G. Dawson Coleman, for want of wood.

The history of this old furnace has been shrouded in so much obscurity and is withal so interesting that we are gratified in being able to present a circumstantial account of it. We introduce this account by reproducing the following narrative, written by Robert Coleman, grandfather of Hon. G. Dawson Coleman, to whom we are indebted for a copy of it from the family records.

Some time previous to the year 1755 Jacob Huber, who then owned the tract of land upon which these works now stand, erected a small furnace there. Like all other new undertakings of this kind, commenced and conducted with but small experience of the business, Huber soon found it expedient to dispose of his establishment. Accordingly he parted with all his estate in the furnace tract, and such other lands as he had acquired, to a company composed of Henry William Stiegel, Charles Stedman, and Alexander Stedman. The Stedmans living at a distance, Stiegel became the active owner and manager of the estate. He accordingly took possession in the year 1757, erected a new furnace, and carried on the works for the space of about eighteen years, during which period he acquired for the use of the company a considerable addition to the furnace lands, and also made some purchases in his own right. In the meantime Mr. Stiegel became embarrassed in his circumstances. He fell largely in debt to Daniel Bennezet, of Philadelphia, for the security of which debt he mortgaged all his undivided third part of the Elizabeth furnace estate to Mr. Bennezet, and not having paid the money proceedings were had upon the mortgage; a *levari facias* issued upon a judgment obtained thereupon, by virtue of which a sale was made by John Ferree, Esq., high sheriff of Lancaster county, to Daniel Bennezet, the mortgagee, who received a deed for the

mortgaged premises dated the 5th of May, 1775. Daniel Bennezet also became the purchaser, at two other and subsequent sheriff's sales, of other lands belonging to Mr. Stiegel.

In the year 1776, possessed of but a small capital, and recently married, I took a lease for the Elizabeth furnace estate for the term of seven years, not anticipating at that time that before the expiration of the lease I should have it in my power to become owner in fee simple of the whole or a greater part of the estate. Success, however, crowned my endeavors. A new and regular system was adopted, by which the business of ironworks was made to resemble more a well-conducted manufactory than the scenes of confusion and disorder which had before that time prevailed in that business. During the continuance of the lease I made several purchases of lands contiguous to the estate, and in the year 1780 I purchased from John Dickinson, Esq., the one undivided third part of the Elizabeth furnace and lands thereunto belonging, he having before that time become the owner of all the estate and interest which Alexander Stedman held in the same. In the year 1784 I purchased out Mr. Charles Stedman, who also held an undivided third part of the estate. The remaining third part of the original estate was not purchased by me from Daniel Bennezet until the year 1794, he either not being inclined to sell or asking more than I thought it expedient to give.

On the furnace erected by Huber, whose first name was probably John, and not Jacob, the following legend was inscribed:

Johan Huber, der erste Deutsche man
Der das Eisenwerk vollfüren kann.

Freely translated, this inscription reads: "John Huber is the first German who knows how to make iron."

Baron Henry William Stiegel, whose eccentricities are described with perhaps too free a hand in Bishop's *History of American Manufactures*, was a native of Manheim in Germany, and according to the most reliable accounts a gentleman of noble birth and great wealth. Elizabeth furnace is said to have been so named by him in honor of his wife. It is situated near Litiz, fourteen miles from Lancaster. Day says that Stiegel founded the village of Manheim, near Elizabeth furnace, in 1762, and erected glassworks as well as the furnace. Bishop states that "some of the first stoves cast in this country were made by Mr. Stiegel, relics of which still remain in the old families of Lancaster and Lebanon counties." These and other early stoves are thus described by the same author.

These were probably the same as the "Jamb stoves" made by Christopher Sower, of Germantown, some of which were cast at or near Lancaster. They

were, it is probable, the first stoves cast in America, and are described as similar in construction to the box form of the old *ten-plate* stoves which superseded them, but they were without a pipe or oven. They were set in the side or "jamb" of the kitchen fire-place, and passed through the wall so as to present the back end in the adjoining room. This, though red hot, but imperfectly warmed the rooms, which, though small, were less impervious to cold air than those of the present day. Dr. Franklin published, in 1744, with a copper-plate illustration, an account of the open stove, or "newly invented Pennsylvania Fire-place, etc.," which bears his name. They were afterward improved by Count Rumford, a native of New Hampshire, who also investigated the subject of heating houses by steam conveyed in metal pipes, which, about the middle of the last century, was proposed by William Cook, of Manchester. Our hardy ancestors, however, depended little on stoves, which were not in general use in dwellings until near the present century, and still later in churches. Cannon stoves were, in 1782, provided as an article of luxury for Christ Church, Philadelphia. The *air-tight* stove is said to have been invented by Isaac Orr, of New Hampshire, who died in 1844, at the age of fifty.

Rev. Joseph Henry Dubbs, of Lancaster, records the fact that Stiegel's stoves bore the inscription:

Baron Stiegel ist der Mann
Der die Ofen machen kann.

That is, "Baron Stiegel is the man who knows how to make stoves."

After Elizabeth furnace came into the possession of Robert Coleman he made shot and shell for the Continental army, and some of the transactions which occurred between him and the Government in settlement of his accounts for these supplies are very interesting. Under date of October 26, 1780, the following entry is made by Mr. Coleman to the credit of The United States: "By cash, received of William Thorne, Pay-Master, 107,319,15-90 dolls., old emission, exchange 73 for one, £551,5,11." In August, 1781, another credit is entered of "328 dolls., new emission, three for one," which shows an appreciation of the currency. Two months later exchange was at two and a half for one. On November 16, 1782, appears the following entry: "By cash, being the value of 42 German prisoners of war, at £30 each, £1260;" and on June 14, 1783, the following: "By cash, being the value of 28 German prisoners of war, at £30 each, £840." In a foot note to these credits Robert Coleman certifies "on honour" that the above 70 prisoners were all ever secured by him, one of whom being returned is to be deducted when he produces the proper voucher. Rupp, in his history of Lan-

caster county, mentions that in 1843 he visited one of the Hessian mercenaries who was thus disposed of at the close of the war for the sum of £80, for the term of three years, to Captain Jacob Zimmerman of said county.

In 1743 William Branson, of Philadelphia, erected two forges on Conestoga creek, near Churchtown, in Lancaster county, which he called Windsor, and which were famous forges in their day. The following circumstantial account of these noted forges and some of their early owners is from a letter we have received from Mrs. Martha J. Nevin, wife of the Rev. Dr. John W. Nevin, of Caernarvon Place, Lancaster.

In looking over an old family record I found the following: "In the year 1700 David Jenkins arrived in Philadelphia from Wales, and settled near the Great Valley Church. His son John, anxious to become acquainted with the resources of his adopted country, penetrated more deeply into the forest and directed his course to the site on which the Windsor forges were afterwards erected. Entered into contract with John, Thomas, and Richard Penn for the purchase of four hundred acres of land, January 10th, 1733. Nine years afterward he sold it to William Branson, of Philadelphia, who in 1742 erected the forges and mansion house."

Wishing to get a particular account, I wrote to James McCaa, Esq., who was one of the executors of my father's estate, (the late Robert Jenkins,) and who had possession of the old Windsor account-books, to look them over, and give me the correct account. I received from him the following: "William Branson & Company, then owners and proprietors of the old Reading furnace, in the year 1742 bought all the interest and improvements that John Jenkins had made on the Windsor tract of 400 acres. He perfected the title in the name of William Branson and immediately began to build. The date on the stone over the door of the lower forge is 1743. The date of the mansion I do not exactly know, but have always understood it was built directly after the completion of the forges. In a short time afterward Mr. Branson sold out to the English company, who were Lynford Lardner, Samuel Flower, and Richard Hockley, Esqs., who held it for thirty years, when, in 1773, David Jenkins, son of the original proprietor, bought the half interest of the company for the sum of £2,500, and in two years afterwards bought the other half for the sum of £2,400, including the negroes and stock used on the premises."

You may depend on this account being thoroughly accurate, as it is taken directly from the old account-books. David Jenkins was my grandfather. My father, Robert Jenkins, inherited Windsor from his father. I was born there.

Robert Jenkins managed Windsor forges with great success for fifty years, dying in 1848. He was a member of the Legislature in 1804 and 1805, and from 1807 to 1811 was a member of Congress. David Jenkins was a member of the Legislature in 1784.

Pool forge, about a mile down Conestoga creek from Windsor forges, was built about 1760, probably by James Old. He at least owned it about that time. Spring Grove forge, on the same stream, about three miles west of Pool forge, was built in 1793. None of these forges were abandoned until after 1856. Until 1813 a large part of Lebanon county, which was formed in that year, was embraced within the limits of Lancaster county.

In Nicholas Scull's map of Pennsylvania (1759) two ironworks are marked at Pottstown, at the mouth of the Manatawny, one on each side of the stream, but their names and their owners' names are not given. We learn, however, from another source, that one of them was a forge named Pottsgrove, the original name of Pottstown, which was laid out in 1752 by John Potts, son of Thomas. Above Pottstown the following ironworks appear on Scull's map in the order named: McCall's forge, Pool forge, and Pine forge, on the Manatawny, and Colebrookdale furnace on the Ironstone branch. The last three enterprises are located in Berks county, but McCall's forge is in Montgomery county. Mayberry's forge and one or two other ironworks east of the Schuylkill are also marked on Scull's map. Pine forge was built before 1747 by Thomas Potts. In 1768 it was owned by his son John. It probably supplanted both the Pool forges. In 1845 it was converted into a rolling-mill, run by water-power, which is still active. Crossing the Schuylkill with Scull, we find Warwick furnace and Reading furnace on French creek, and Windsor forge, in the order named—the first two in Chester county and the last in Lancaster county. Coventry forge is not noted, but it was certainly in operation in 1756, as an official statement made in 1757 shows, and in 1770 it is noted on William Scull's map of Pennsylvania. It was in operation after the Revolution, and in 1856 a forge of the same name, which is now abandoned, was in operation at or near the original site. In Israel Acrelius's *History of New Sweden*, written about 1756, mention is made of a forge attached to Warwick furnace, and of another attached to Reading furnace, one of which was beyond doubt Coventry. The historian says: "Each has his own furnace—Branz at Reading, Nutt at Warwick. Each also has his own forges—Branz in Windsor. Nutt supplies four forges besides his own in Chester county."

The first steel works in Pennsylvania are said by Mrs. James and others to have been erected on French creek, in Chester county, prior to 1734, by Samuel Nutt, but William Branson was probably associated with him in this enterprise. Branson appears to

have owned the works in 1737. Samuel Nutt, in his will, written in that year, makes no mention of them. They were known as the Vincent steel works. In 1756 they were owned by William Branson, and are thus described by Acrelius, the Swedish historian: "At French creek, or Branz's works, there is a steel furnace, built with a draught-hole, and called an 'air oven.' In this, iron bars are set at the distance of an inch apart. Between them are scattered horn, coal-dust, ashes, etc. The iron bars are thus covered with blisters, and this is called 'blister-steel.' It serves as the best steel to put upon edge-tools. These steel works are now said to be out of operation."

In 1750 there was a plating forge with a tilt-hammer in Byberry township, in the northeastern part of Philadelphia county, the only one in the province, owned by John Hall, and two steel furnaces within the city limits, one of which (Paschal's) was built in 1747, and stood on a lot at the northwest corner of Eighth and Walnut streets: the other was owned by William Branson. There appear to have been no other steel furnaces in operation in the province in 1750. Hall is said to have established a bloomary forge on White Clay creek, in New Castle county, about 1734. He was a grandson of Thomas Rutter, and oldest son of Joseph and Rebecca (Rutter) Hall.

At an early day there were two iron enterprises in that part of Chester county which is now embraced in Delaware county. These were, a forge on Crum creek, about two miles above the town of Chester, built by John Crosby and Peter Dicks about 1742, and a rolling and slitting mill on Chester creek, in Thornbury township, where Glen Mills now stand, built in 1746 by John Taylor. The forge on Crum creek was in operation as late as 1756, when Acrelius says it was owned by Peter Dicks, had two stacks, was worked sluggishly, and had "ruined Crosby's family." This last statement is discredited by a local historian. In 1748 Peter Kalm, a Swedish traveler, wrote that the ore for the Crum creek forge was obtained thirty or forty miles away, where it was first melted in an oven and then carried to the forge. The bellows at this forge were made of leather. Taylor's enterprise was named Sarum ironworks, and embraced a forge as well as a rolling and slitting mill. In September, 1750, John Owen, sheriff of Chester county, certified to the Lieutenant-Governor of Pennsylvania that Sarum had been in operation until June of that year. After this time the British government had interdicted the further employment of rolling and

slitting mills in the colonies. We can not learn whether Mr. Taylor long obeyed this decree, but it is said that his works were carried on with energy until his death in 1756. Acrelius, writing about the time of Taylor's death, says: "Sarum belongs to Taylor's heirs; has three stacks, and is in full blast." Peter Kalm states that at Chichester (Marcus Hook) "they build here every year a number of small ships for sale, and from an ironwork which lies higher up in the country they carry iron bars to this place and ship them." This "ironwork" was probably Sarum. Taylor was the descendant of an English settler in the province. His rolling and slitting mill was the first in Pennsylvania.

Development of the Cornwall Ore Hills.—Cornwall furnace, mentioned before as having been built by Peter Grubb in 1742, was located within the limits of the since celebrated Cornwall ore hills, in Lebanon county, and is now running. It is the oldest furnace in the country that is still in operation. The Cornwall ore hills, which literally comprise three mountains of almost pure magnetic iron ore, were conveyed by John Penn, Thomas Penn, and Richard Penn, proprietors-in-chief of the province of Pennsylvania, and counties of Newcastle, Kent, and Sussex on the Delaware, by their warrant dated London, May 8, 1732, to Joseph Turner, of Philadelphia, for five hundred pounds, money of Pennsylvania. The grant embraced 300 acres. Turner assigned the entire tract to William Allen, April 5, 1734, and on the 28th and 29th of November, 1737, Allen assigned the same to Peter Grubb, to whom a patent was issued August 2, 1745. Peter Grubb died intestate about 1754, and the estate descended to Curtis Grubb and Peter Grubb, Curtis receiving two-thirds under the intestate law of that day, and Peter one-third. Both sons were colonels in the Revolution. June 28, 1783, Curtis conveyed a one-sixth interest to Peter Grubb, Jr., his son. By articles of agreement, dated September 26, 1785, Peter Grubb, Jr., grandson of the first-named Peter Grubb, and son of Curtis Grubb, sold to Robert Coleman his share of the Cornwall ore hills, Cornwall furnace, and appurtenances, reserving the right for a sufficient quantity of ore for one furnace, which right is held and exercised to-day by Ferguson, White & Co., the proprietors of Robesonia furnaces in Berks county. The deed for the share sold to Robert Coleman, signed by Peter Grubb, Jr., and Mary his wife, is dated May 9, 1786.

After that year Robert Coleman, through successive purchases from the Grubbs, acquired four additional sixths of the property originally conveyed by the Penns to Joseph Turner. At his death in 1825 his estate was devised to his four sons, and at the present time, under various partitions that have since taken place, the interest of Robert Coleman is vested in his grandsons, Robert and G. Dawson Coleman, and in the heirs of his grandsons, William and Robert W. Coleman, while one-sixth still continues as the property of the descendants of Peter Grubb. Neither the Coleman nor the Grubb family limited its operations in the last century to the Cornwall "ore banks and mine hills," but each became the owner of many other iron properties. Both families are now prominently engaged in the manufacture of pig iron—the heirs of William and Robert W. Coleman owning five anthracite furnaces and the old Cornwall charcoal furnace, G. Dawson Coleman owning three furnaces, and the heirs of Peter Grubb owning, in whole or in part, eight furnaces.

During the Revolution Cornwall furnace cast cannon and shell and shot for the Continental Congress. Colebrook furnace, a near neighbor of Cornwall furnace, is frequently said to have been built in 1745. This statement is an error, traceable doubtless to a confounding of this furnace with Colebrookdale furnace in Berks county. Colebrook furnace was built by Robert Coleman in 1791.

John Grubb, the father of Peter Grubb, 1st, who built Cornwall furnace, was a native of Cornwall, in England, whence he emigrated to this country in 1692, landing at Grubb's Landing, on the Delaware, near Wilmington. He was a member of the Provincial Legislature of Pennsylvania from 1694 to 1698. He is buried in the Swedes' graveyard, at Wilmington. Peter Grubb, his son, was born at Grubb's Landing. We are unable to ascertain the exact time when he embarked in the manufacture of iron in Lancaster county. Hazard intimates that he commenced operations as early as 1728, but we can find no proof that he did. A tradition in his family says that he built a furnace in 1735 about five-eighths of a mile from the site of Cornwall furnace, and cinder is pointed out to sustain the tradition. But this supposed furnace was undoubtedly a bloomary, which may be regarded as Mr. Grubb's first iron enterprise. The earliest record evidence of his connection with ironmaking in Lancaster county is believed to be contained in "ye leace" of Cornwall ore lands, in 1739, by Peter Grubb to Samuel Grubb and Joseph Taylor. In this lease Peter Grubb is

styled an "ironmaster," and it says that he "intends to build an iron furnace" on land adjacent to that leased to Samuel Grubb and Joseph Taylor. That furnace was undoubtedly Cornwall furnace, built in 1742. Hopewell forge was built about the same time by Peter Grubb. On the same stream Speedwell forge was subsequently built, probably by James Old, about 1760. These forges were on Hammer creek, within the present limits of Lancaster county. Mount Hope furnace, built by Peter Grubb, Jr., in 1785, and still active, is on the Big Chiquisalunga creek, in Lancaster county, about ten miles south of Lebanon. In Acrelius's history, written about 1756, appears the following statement:

> Cornwall, or Grubb's ironworks, in Lancaster county. The mine is rich and abundant, forty feet deep, commencing two feet under the earth's surface. The ore is somewhat mixed with sulphur and copper. Peter Grubb was its discoverer. Here there is a furnace which makes twenty-four tons of iron a week, and keeps six forges regularly at work—two of his own, two belonging to Germans in the neighborhood, and two in Maryland. The pig iron is carried to the Susquehanna river, thence to Maryland, and finally to England. The bar iron is sold mostly in the country and in the interior towns; the remainder in Philadelphia. It belongs to the heirs of the Grubb estate, but is now rented to Gurrit & Co.

Martic forge, near the present village of Colemanville, Lancaster county, built in 1755, was one of the two forges "belonging to Germans in the neighborhood." From about 1825 to 1850 steel was made here.

Robert Coleman was born near Castle Fin, in Donegal county, and not far from the city of Londonderry, in Ireland, on the 4th of November, 1748. In 1764, when 16 years old, he left Ireland for America. Arriving in Philadelphia he presented letters of introduction to Blair McLanahan and the Biddles, who recommended him to Mr. Read, Prothonotary at Reading, Pa., in whose employment he remained two years as a clerk. He left Reading and entered the service of Peter Grubb, 2d, as clerk at Hopewell forge. Here he remained six months, and then left to accept a situation at Quitapahilla forge, near Lebanon, the property of James Old. Mr. Old, moving some time after from Speedwell forge to Reading furnace on French creek, took Robert Coleman with him. While at this furnace Mr. Coleman married Ann Old, the daughter of his employer. The marriage ceremony was performed by Rev. Thomas Barton, at the furnace, on Monday, October 4, 1773. Fourteen children blessed this union. Soon after his marriage Mr. Coleman

rented Salford forge, near Norristown, where he remained three years. His grandson, G. Dawson Coleman, has in his possession a document of rare interest, illustrative of Revolutionary experiences at Salford forge. It is indorsed: "Robert Coleman's memorial, presented August 26th, 1776, asking permission for his clerk and three forgemen be exempted from marching with the army to Amboy." It represented that the memorialist was an officer in Colonel Potts's battalion, and was then on his march to Amboy; that he had rented a forge for three years at a rental of "two hundred a year," the lease of which would expire in three months; and that the "principal part" of his workmen were Associators, who, if obliged to march with the militia, would cause him great loss and entirely prevent him from working up his stock in hand. The request of Mr. Coleman was granted the same day by the Council of Safety, to whom it was addressed. While at this forge Mr. Coleman manufactured chain bars, which were designed to span the Delaware river for the defense of Philadelphia against the approach of the enemy's fleet. From Salford forge Mr. Coleman removed in 1776 to Elizabeth furnace, which he first rented and afterwards purchased. In 1809 he retired from active business and removed to Lancaster, where he died August 14, 1825, aged almost 77 years. His remains rest in the Episcopal burying-ground. During his long life he held various positions of honor. He served with credit as an officer in the Pennsylvania militia during the Revolution; was a member of the State Convention which framed the Constitution of 1790; was for several years a member of the State Legislature; raised and commanded a troop of cavalry during the whisky insurrection; was a Presidential elector at-large in 1792, and a Presidential elector for his Congressional district in 1796; and for nearly twenty years was an associate judge for Lancaster county. For more than a quarter of a century he was the most prominent ironmaster in the State. Mrs. Coleman, who was born in 1756, survived her husband many years, dying in 1844, aged 88 years.

We are unable to give much information about James Old. Like many other Pennsylvania ironmasters of his day, he was a native of Wales. He was unquestionably a man of great enterprise and a most successful ironmaster. Mr. Old was a member of the Legislature in 1791, 1792, and 1793. He married Margaret Davies, daughter of Gabriel Davies, who bore him seven children, sons and daughters, but it is probable that he has now no living

descendants who bear his name. Jefferson, in his *Notes on Virginia*, written in 1781 and 1782, speaks of an iron mine in Albemarle county, on the north side of the James river, which was owned by a person named Old. Margaret Old, a daughter of James Old, married Cyrus Jacobs, who was the owner or lessee for many years of Pool and Spring Grove forges on Conestoga creek, and a noted ironmaster in his day. The Jacobs family came to Pennsylvania about 1700, and settled on Perkiomen creek.

Valley Forge, in Chester county, has historic associations which no American can ever forget. This forge seems to have been erected some time prior to 1757 by Stephen Evans, whose executors sold it in that year to John Potts. There is a misty tradition, however, that it was built at a much earlier day by a person named Walker, an Englishman, who came over with William Penn. Its original name was Mount Joy, which name is said to have been given to the neighboring mountain by William Penn. This was also the name of a manor owned by him on the Schuylkill. The forge was located near the mouth of East Valley creek, on the Chester side of the creek—the creek forming a part of the boundary between Chester and Montgomery counties. The forge was destroyed by the British in 1777, just prior to Washington's occupation of the vicinity for winter quarters. It was rebuilt after the Revolution, probably by David and Isaac Potts. The iron used at Valley forge was made at Warwick furnace, which continued in operation during a part of almost every year from its erection in 1737 down to 1867, when its last blast came to an end and the furnace was abandoned.

The foregoing information about Valley forge was obtained with much difficulty and from various sources. Since writing the above, however, we have received a yet more circumstantial account of this historic forge, the particulars of which were kindly obtained for us, after much personal investigation, by Joseph E. Thropp, Esq., of West Conshohocken, Montgomery county. It is as follows:

Valley forge was built on the western side of Valley creek, in Chester county. The original site was about five-eighths of a mile from the mouth of the creek. It was owned and operated by members of the Potts family from the spring of 1757 until its destruction by the British about two months before the American army encamped there in 1777. From 1771 Col. William Dewees, son of Sheriff William Dewees of Philadelphia, was associated with the Potts's, and in 1773 appears to have bought an interest. The iron used at this forge was hauled by teams from Warwick furnace. After the close of the

war another forge was erected about three-eighths of a mile farther down the stream, on the Montgomery county side, on ground now covered by part of the cotton and woolen factory, and a new dam was built, raising the water partly over the site of the old Mount Joy forge. (This second forge was in ruins in 1816.) About the same time a slitting-mill was erected on the Chester county side, most probably being constructed out of one of the buildings used by the artisans for the army. The forge and slitting-mill were built by Isaac Potts and his brother David. In 1786 they were operated under the firm name of "Isaac Potts & Co.," the company consisting of David (Isaac's brother) and his son James. The property subsequently passed through the hands of Joseph Potts, Ralph Peacock, Rebecca Robbins, and Jacob Vogdes, until in 1814 the latter, who had not operated the works, sold them to John Rogers and Joshua Malin. Malin, who was a cousin of Rogers, was the manager. He rebuilt the rolling and slitting mill, making it about 30 feet wide by 80 feet long. There was a "tilt mill" in one end, and between the main building and the dam a small foundry, the cupola of which was blown by a water blast. He also commenced a three-story stone building on the Montgomery county side, which is still standing, and constitutes part of the present cotton factory. This was intended for the manufacture of hardware. In 1816 Malin became involved, and John Rogers was by suit proven to be his partner and compelled to pay his debts. April 1st of that year Rogers bought Malin's half interest in the property, and in the fall of the year James Wood went there as a partner of John Rogers and manager of the works. Isaac Smedley was also a member of the firm. Wood completed the mill which was intended by Malin for a hardware factory, and made it into a saw factory principally, though shovels, spades, files, etc., were also made. He also operated the rolling-mill, making boiler plate and sheet and band iron. Part of this was slit for the nail mill at Phœnixville, where as yet they had no such facilities. (Lewis Wernwag operated the nail mill at Phoenixville at the time.) Malin had made nails by hand in a frame building nearer the road. The iron used by Wood in the rolling-mill was obtained from Laurel forge, Coventry forge, and Springton forge.

About 1818 Rogers sent John Parkins and his son John, Jr., to Wood to see if they could successfully make cast steel, to be used in their saws. These men had during 1812 made an attempt to make cast steel in New York City, but failed. A furnace was built in the back end of the rolling-mill, but did not prove large enough; then a large stack was erected between the rolling-mill and the smith-shop, (part of the smith-shop is still standing and used as a stable,) and six furnaces were built around it. Here cast steel of good quality for use in saws was made. Sixty barrels of clay for crucibles were brought from Perth Amboy. Early in 1821 Brooke Evans, of Sheffield, England, went to Valley Forge, having leased the property from Rogers. He converted the saw factory and rolling-mill, then being vacated by James Wood, into gun factories. He raised the roof of the rolling-mill and added two stories to it. (He made at Valley Forge 20,000 muskets.) This building was subsequently destroyed by a freshet and no traces of it remain. The building on the Montgomery county side, after being vacated as a gun factory, was enlarged and converted into a cotton and woolen factory.

Continued Development of the Iron Industry of Eastern Pennsylvania.—Berks county was a busy iron centre before the Revolution, as it is to-day. We have already mentioned its earliest iron enterprises, and now add some others. David Jones, a Welshman, settled on 1000 acres of land in Caernarvon township in 1735, and soon afterwards became prominent as an ironmaster. He was the ancestor of the Hon. J. Glancy Jones. Charming forge, near Womelsdorf, was erected in 1749, and is still active. Hopewell furnace, in the southeastern corner of Berks county, on French creek, was built in 1759 by William Bird, an enterprising Englishman, who is said to have built a forge at Birdsboro in 1740, and who originated other iron enterprises. The furnace is still active. He built Roxborough furnace, in Heidelberg township, some time prior to his death, which occurred in 1763. The name of this furnace was afterwards changed to Berkshire. He was succeeded by his son, Mark Bird, who built a rolling and slitting mill and a nail factory at Birdsboro about the time of the Revolution. He also built Spring forge in Oley township, and Gibraltar forges, in Robeson township. At Trenton, New Jersey, he manufactured wire. He failed in business about 1788. The town of Birdsboro, in Berks county, now the seat of the extensive ironworks of Messrs. E. & G. Brooke, was named after William Bird. Oley furnace, eleven miles northeast of Reading, was built about 1770, and is still active. Oley forge, on Manatawny creek, was built in 1780, and was in operation as late as 1856. These were Mr. Udree's enterprises. Green Tree forge was built in 1770. Reading furnace, in Heidelberg township, Berks county, was erected in 1793, by George Ege, and was in operation until about 1850. Other old furnaces in this county include Joanna, built in 1792, rebuilt in 1847, and still in the active list; Sally Ann, built in 1791 and in operation in 1856; and Mary Ann, built in 1797 and also in operation in 1856. Other old forges were built as follows: the two Rockland forges, six miles southeast of Kutztown, in 1788 and 1790, and the two District forges, in Pike township, in 1797 and 1800. In 1798 there were six furnaces and six forges in Berks county. In 1832 there were eleven furnaces and twenty-one forges.

Maria forge, in Carbon county, was built in 1753, and a blast furnace soon followed it. They stood on Poco creek, a short distance east of Weissport. The forge was abandoned in 1858, and the furnace in 1861.

There was a bloomary forge in York county in 1756, owned by

Peter Dicks, of Chester county. Spring forge, in the same county, was built in 1770. Pine Grove furnace, in Cumberland county, was built in the same year by Thornburg & Arthur, and about 1800 it was sold to Michael Ege, Sr. About the year 1770 a furnace was built at Boiling Springs, in this county, forming the nucleus of the Carlisle ironworks, which afterwards, about 1782, included a forge, a rolling and slitting mill, and a steel furnace. Michael Ege, Sr., was the proprietor. These works are still in operation, C. W. & D. V. Ahl being the owners. Many other furnaces and forges were built in Eastern Pennsylvania prior to the Revolution, and also some bloomaries.

After the Revolution, and even before its close, the business of making iron in Pennsylvania received a fresh impulse and was extended into the interior of the State. Bishop states that the first furnace built in Franklin county was Mount Pleasant furnace, in Path valley, erected soon after the peace of 1783 by three brothers, William, Benjamin, and George Chambers. A forge was erected as early as 1783. This forge and furnace were four miles northwest of Loudon, and were destroyed in 1843. Soundwell forge, sixteen miles north of Chambersburg, on Conodogwinet creek, was built in 1790, and was active in 1855. Carrick forge, four miles from Fannettsburg, in Franklin county, was built in 1800, and was in operation in 1856. A furnace of the same name was built in 1828, which is still active. Mont Alto furnace, in the same county, was built in 1807, and is still active. Two forges of the same name, which are yet in operation, were built in 1809 and 1810 about four miles from the furnace. In 1832 Mont Alto rolling-mill was built. Loudon forge and furnace were built about 1790 by Colonel James Chambers, and destroyed about 1840. Valley forge, near Loudon, in Franklin county, was built in 1804, and abandoned after 1856. Other old forges in Franklin county were abandoned before 1850. Liberty forge, on Yellow Breeches creek, in Cumberland county, was built in 1790, and is still active. Other forges in Cumberland county were built prior to 1800. Cumberland furnace, ten miles southwest of Carlisle, on Yellow Breeches creek, was built in 1794. Holly furnace, at Papertown, in the same county, is said to have been built in 1795. A forge was in existence here in 1848. Both of these furnaces were built by Michael Ege, Sr. They have long been abandoned. A paper mill now occupies the site of Holly furnace. Two furnaces, now abandoned, once stood near

Shippensburg in this county—Mary Ann, built in 1826, and Augusta, built in 1828. Southampton furnaces, Nos. 1 and 2, and Mary furnace, all near Shippensburg, but in Franklin county, are also abandoned. A large forge near Southampton furnaces was torn down in 1849. Big Pond, built in 1836, at Newville, in Cumberland county, is still on the active list as a charcoal furnace.

Franklin and Cumberland counties were very busy iron centres during the first half of the present century. We have mentioned chiefly their early iron enterprises. One of their later enterprises was Caledonia furnace, in Franklin county, ten miles east of Chambersburg, which was built in 1837, and owned in 1863 by Hon. Thaddeus Stevens, in which year it was burned by the Confederates, under General Lee, when on the march to Gettysburg. Another embraced Warren furnace and forge, in the southwestern corner of Franklin county. William Bowers built the forge in 1830 and the furnace in 1835. Both stopped running in 1856. In 1840 there were 8 furnaces and 11 forges, bloomaries and rolling-mills in Franklin county, and 6 furnaces and 5 forges and rolling-mills in Cumberland county.

We are indebted to Hon. Frederick Watts, of Carlisle, for the following information concerning the distribution of the iron property of Michael Ege, Sr., who was for nearly fifty years a prominent ironmaster of Cumberland county, owning, as we have shown, Pine Grove furnace, the Carlisle ironworks, Holly furnace, and Cumberland furnace. At his death, in 1815, his son, Peter Ege, owned Pine Grove furnace; another son, Michael Ege, Jr., the Carlisle ironworks; another son, George Ege, Holly furnace, and a daughter, Mrs. Eliza Wilson, Cumberland furnace.

Bishop says that in 1786 there were seventeen furnaces, forges, and slitting-mills within thirty-nine miles of Lancaster. In the next twenty-five years a large number of forges and furnaces were built in Lancaster and Chester counties, and in both counties, but particularly in Chester county, rolling-mills were established. In 1790 Benjamin Longstreth erected a rolling and slitting mill at Phœnixville, where the foundry now stands, to roll bars into plates to be slit into nail rods. This was the beginning of the present extensive works of the Phœnix Iron Company. Rokeby rolling-mill, on Buck run, four miles south of Coatesville, was built in 1795, and Brandywine rolling-mill, at Coatesville, was built in 1810. The puddle-mill of the latter works, now called Lukens, operated by water-power, occupies the site of the original

mill, which was the first plate-mill built in the United States, as we are informed by the present proprietors. Mary Ann forge, two miles north of Downingtown, was built in 1785, and Springton forge, five miles north of Mary Ann forge, was built in 1790. Both of these forges are still active. Hibernia forge, on West Brandywine creek, four miles north of Coatesville, was built in 1793, and is still in operation in connection with a small rolling-mill which was added in 1837. Sadsbury forges, on Octorara creek, near Penningtonville, were built in 1800 and 1802, and one is still in operation. Brooke forge, near Pequea, in Lancaster county, was built in 1795, and Pine Grove forge, sixteen miles south of Penningtonville, on Octorara creek, in the same county, was built about 1800. A small rolling-mill, which is now abandoned, was added in 1844, on the Chester county side of the creek. Pleasant Garden forge, on the Brandywine, five miles southeast of Oxford, was built in 1806 and abandoned about 1848. A small rolling-mill was built in 1845, which is also abandoned.

In 1838 there were in existence, within a radius of fifty-two miles of Lancaster, 102 furnaces, forges, and rolling-mills.

At Columbia and Marietta in Lancaster county there were in 1876 eleven furnaces, the oldest of which, Sarah Ann, a charcoal furnace, was not built until 1841. In 1845 it was changed to anthracite. All the others use anthracite when running.

In 1805 there were two forges in York county. Castle Fin forge, on Muddy creek, in York county, was built in 1811 by a person named Withers, and rebuilt in 1827 by Thomas Bird Coleman, who also erected a steel furnace in 1832 or 1833. Margaretta furnace, on Cabin Branch creek, was erected in 1823, and a forge called Woodstock was erected at the same place in 1828. Both have been abandoned. Codorus furnace and forge, on a creek of the same name, were built by Henry B. Grubb, and abandoned before 1850. York furnace, at the mouth of Otter creek, was built in 1830, and is still active. A short time prior to 1830 a furnace called Susan Ann, or Manor, was built by William S. Cornwell near the Brogue tavern in York county. A furnace at York made all kinds of castings in 1832, when it was owned by Israel Gardner. In 1843 there were two furnaces and four forges within the county limits. In 1850 there were five furnaces and three forges. Since 1850 the iron industry in the county has declined.

In 1805 there were seven forges and one slitting-mill in Delaware county. Franklin rolling-mill, at Chester, in Delaware county, was

built in 1808. In 1828 there were five rolling and slitting mills in this county, and some manufactories of finished iron products.

The iron industry in the Lehigh valley was confined to a few charcoal furnaces and forges and one rolling-mill until its first anthracite furnace was built in 1840. There was a forge at Easton before 1778, named Chelsea. In 1808 William Henry, of Nazareth, built a forge in Northampton county, which was started in 1809, making its first bar of iron on the 9th of March. In 1824 Matthew S. Henry built a furnace which made its first ton of pig iron on the 10th of May, 1825. Hampton furnace, near Sheimersville, in Lehigh county, was built in 1809. In 1826 Stephen Balliet built a furnace in Lehigh county, near the Blue mountains, called Lehigh. In 1832 there were in Lehigh county a furnace and forge owned by Mr. Balliet, and a furnace and two forges owned by Mr. Heinbaugh—probably Hampton furnace. In Northampton county there were in the same year one furnace and three forges in operation. In 1836 a rolling-mill and wire factory were built at South Easton, in Northampton county, by Stewart & Co. Now, of all the iron districts in the country, the Lehigh valley ranks second only to Pittsburgh in the yearly value of its iron products, while it ranks first in the list of pig iron districts. It has several large rolling-mills and fifty anthracite furnaces. The Bethlehem Iron Company owns six furnaces and one of the most complete iron and steel rolling-mills in the world.

About the year 1778 a bloomary forge was built on Nanticoke creek, near the lower end of Wyoming valley, in Luzerne county, by John and Mason F. Alden. Another bloomary forge was erected in 1789 on Lackawanna river, about two miles above its mouth, by Dr. William Hooker Smith and James Sutton. Still another bloomary forge was erected in 1799 or 1800, on Roaring brook, at Scranton, then called Slocum's Hollow, by two brothers, Ebenezer and Benjamin Slocum. The product of these bloomaries was taken down the Susquehanna river in Durham boats. They all continued in operation until about 1828.

About 1789 there were fourteen furnaces and thirty-four forges in operation in Pennsylvania, according to a list published by Mrs. James. In 1791 the number of furnaces had increased to sixteen, and of forges to thirty-seven.

Most of the bar iron made in the last century in Pennsylvania was hammered at the forges out of blooms made from pig iron. But little was made from blooms produced in the bloomary fire di-

rectly from the ore, as was the New England custom. The Pennsylvania furnaces were also employed in making castings, such as stoves, pots, kettles, etc. The stove which Franklin invented was first cast at Warwick furnace about 1742, by his friend, Robert Grace, who carried on the furnace in right of his wife, the widow of Samuel Nutt, Jr. But the first bar iron made in the province, by Thomas Rutter, Samuel Nutt, and others, was made in forges, sometimes called bloomary forges, directly from the ore. During the Revolution cannon and cannon-balls were cast at the Pennsylvania furnaces for the Continental army. Sixty cannon were cast at Warwick furnace alone in 1776.

The early Pennsylvania furnaces made from ten to twenty-five tons of pig iron or castings in a week, the highest limit being seldom attained. As all the furnaces were blown by water-power, and as the water failed in the summer season, a fair yield by one furnace in a year was 500 tons of iron. The size of the furnaces seldom exceeded twenty-five feet in height and seven feet in width at the bosh. The fuel used was exclusively charcoal, and the blast was always cold. Only one tuyere was used. Leather bellows were at first used, but wooden bellows, or tubs, were afterwards substituted. These tubs are still in use in connection with some of our oldest furnaces. Warwick and Cornwall furnaces were each over thirty feet high. These and some other furnaces each yielded in the last century as much as 1,000 tons of iron annually. In 1731 pig iron sold at Colebrookdale furnace at about $15 a ton. Castings cost about twice as much as pig iron. The forges made from sixty to one hundred and fifty tons of bar iron in a year, which sold at from $75 to $100 a ton.

The bar iron and castings made in the Schuylkill valley during the last century were taken down the river to Philadelphia in boats, which were poled back to their starting points with great labor.

The following notice of the workmen employed in making iron in Pennsylvania prior to the Revolution and of the prices of iron is taken from Acrelius's *History of New Sweden*, written about 1756.

The workmen are partly English and partly Irish, with some few Germans, though the work is carried on after the English method. The pig-iron is smelted into "geese," ("gœsar,") and is cast from five to six feet long and a half foot broad, for convenience of forging, which is in the Walloon style. The pigs are first operated upon by the finers, (smelters). Then the chiffery, or hammer-men, take it back again into their hands, and beat out the long bars. The finers are paid 30*s.* a ton and the hammer-men 23*s.* 9*d.* per ton; that is

to say, both together, £2 13*s.* 9*d.* The laborers are generally composed partly of negroes, (slaves,) partly of servants from Germany or Ireland bought for a term of years. A good negro is bought for from £30 to £40 sterling, which is equal to 1500 or 2000 of our dollars, koppar mynt. Their clothing may amount to 75 dollars, koppar mynt, their food, 325 ditto—very little, indeed, for the year. The negroes are better treated in Pennsylvania than anywhere else in America. A white servant costs 350 dollars, koppar mynt, and his food is estimated at 325 dollars more, of the same coinage. For four months, in summer, when the heat is most oppressive, all labor is suspended at the furnaces and forges. Pig-iron is sold at the furnaces for from £3 6*s.* 8*d.* to £3 10*s.* per ton. Bar-iron at the forge brings £20 per ton, or 20*s.* per 100 pounds. It is sold dear, for six months' credit is given. Pig-iron is sold in Philadelphia at £5 per ton; bar-iron, in large quantities, at from £14 to £16 per ton. It certainly seems remarkable that the price is diminished after the long transportation to the city; but in this people find their profit.

The iron-works of Pennsylvania lie mostly within forty miles of Philadelphia. The carriage for such a distance does not exceed twenty shillings sterling per ton. As a set-off to this is reckoned the return-freight upon goods serviceable for the storehouse of the works.

The following description of the methods employed in forging iron by our English ancestors is taken from *Bishop's History of American Manufactures.* These methods were substantially the same as those in use in this country during the last century.

John Ray, F. R. S., has left on record a description of the process of forging iron as practiced in Sussex, England, in 1674. The forge had two hammers, one called the finery, the other the chafery. At the former the metal was brought into the state of blooms and anconies. The bloom was a four-square mass, two feet long, prepared by beating a loop, or mass of metal weighing about three-fourths cwt., with iron sledges upon an iron plate, and afterwards with the forge-hammer worked by water. This was called shingling the loop. After two or three more heats at the finery, the mass was brought to an ancony, the middle of which was a square bar of the desired size, and the two ends of rough square lumps. At the chafery the bar was completed by reducing the ends to a uniform size with the middle portion. Three loads of large wood-coal made a ton of iron at the finery, and one load of small coals at the chafery. A man and boy at the finery would make two tons of iron per week, and two men at the chafery would make five or six tons a week.

John Houghton, F. R. S., (*Husbandry and Trade Improved,*) in 1697 says both the finery and chafery were open hearths covered with heaps of coals, blown by bellows in the same way as the furnaces, but not so large; and the sow and pigs received five heats in the two—two at the finery and three at the chafery. He calls the thick square first made a half bloom, and the bar with the two knobs a bloom, the greater end being called the mocket head, and the less the ancony end. At the fourth heat the mocket head was reduced, and at the fifth the ancony end, to the state of a bar.

First Ironworks in the Juniata Valley.—The first blast furnace in the Juniata valley was Bedford furnace, built in 1785 on the site of the present town of Orbisonia, in Huntingdon county, by the Bedford Company, composed of Edward Ridgley, Thomas Cromwell, and George Ashman. It made from eight to ten tons of pig iron a week. Lytle, in his *History of Huntingdon County*, says it was constructed mostly of wood, and was five feet wide at the bosh and either fifteen or seventeen feet high. A forge was built on the same creek, by the Bedford Company, a short distance from their furnace, about 1785, which supplied the neighborhood with horseshoe iron, wagon tire, harrow teeth, etc. Large stoves and other utensils were cast at Bedford furnace. The entire product of the furnace was converted into castings and bar iron. At the Philadelphia Exhibition was a stove-plate cast at this furnace in 1792. On the 10th of September, 1793, Thomas Cromwell, for the company, advertised in the *Pittsburgh Gazette* castings and bar iron for sale at Bedford furnace. The first American bar iron ever taken to Pittsburgh is said to have been made at Bedford forge. There was then no wagon road to Pittsburgh. "In the forge the pig iron of the furnace was hammered out into bars about six or eight feet long, and these were bent into the shape of the letter U and turned over the backs of horses and thus transported over the Alleghenies to Pittsburgh." Bar iron and castings from Bedford furnace and other ironworks in the Juniata valley were taken down the Juniata river in arks, many of them descending to as low a point as Middletown on the Susquehanna, whence the iron was hauled to Philadelphia. Much of the iron of the Juniata valley was also sent to Baltimore in arks down the Susquehanna river.

Centre furnace, located about nine miles southwest of Bellefonte, in Centre county, was the second furnace erected in the Juniata valley or near its boundaries. It was built in the summer of 1792 by Colonel John Patton and Colonel Samuel Miles, both Revolutionary officers. The first forge in Centre county was Rock forge, on Spring creek, six miles south of Bellefonte, built in 1793 by General Philip Benner, who subsequently originated other iron enterprises in the same county, and became an extensive shipper of Juniata iron. He died in 1833, aged seventy years, long before which time his Rock forge enterprise had expanded into a rolling and slitting mill, nail factory, furnace, etc. The furnace was built in 1816. Benner came from Chester county, where he had made iron at Nutt's forge at Coventry after the Revolution. In

1795 Daniel Turner erected Spring Creek forge, and in 1796 Miles Dunlap & Co. had Harmony forge on Spring creek in operation. Logan furnace, near Bellefonte, was built in 1800 by John Dunlap. Andrew Boggs and John Royer operated this furnace about 1805–6–7, under a lease from John Dunlap, the firm-name being Boggs & Royer. Tussey furnace, fourteen miles south of Bellefonte, was built about 1805 by William Patton. In 1807 Roland Curtin, a native of Ireland, and father of Governor Andrew G. Curtin, erected a forge on Bald Eagle creek, about four miles from Bellefonte, and in 1817 he built a furnace called Eagle. In 1831 a small rolling-mill was added, for the manufacture of bar iron and nails. About 1820 Hardman Phillips erected at Phillipsburg a forge and screw factory—the latter one of the first of its kind in this country. Cold Stream forge was erected about the same time by John Plumbe, Sr., in Rush township, Centre county.

Barree forge, between the villages of Spruce Creek and Petersburg, in Huntingdon county, and nine miles west of Huntingdon, on the Little Juniata, was built about 1794 by Edward Bartholomew and Greenberry Dorsey, to convert the pig iron of Centre furnace into bar iron. The pig iron was hauled in wagons about thirty miles over rough roads. Huntingdon furnace, in Franklin township, was built in 1796, four miles from the mouth of Spruce creek, on Warrior's Mark run, but the location selected was too far up the stream to secure the requisite power, and after one or two blasts a new stack was built a mile lower down. The furnace was built for Mordecai Massey and Judge John Gloninger by George Anshutz, who in 1808 became the owner of one-fourth of the property. At the same time George Shoenberger purchased a one-fourth interest. Prior to 1808 Martin Dubbs became part owner, and for a time the furnace was carried on by John Gloninger & Company, Dubbs being the "Co." Massey, who was a land speculator, never seems to have been directly interested in the management of the furnace after its erection, although continuing to own an interest in it and the greater part of the lands upon which it was erected down to 1808, when the sale to George Anshutz and George Shoenberger took place and Massey retired absolutely. For these details of ownership we are indebted to Milton S. Lytle, Esq., of Huntingdon, who has taken the pains to examine the official records. A forge called Massey was connected with Huntingdon furnace, and was probably built about 1800. It stood on Spruce creek, about one mile and a half east of the furnace.

The furnace has been cold since 1870. Tyrone forges, on the Little Juniata, six miles west of Spruce Creek, were established by the owners of Huntingdon furnace, the first of the forges in 1804. In 1832 Gordon stated that these forges, with a rolling and slitting mill and nail factory attached, formed "a very extensive establishment," owned by Messrs. Gloninger, Anshutz & Co. "The mill rolls about 150 tons, 75 of which are cut into nails at the works, 50 tons are slit into rods and sent to the West, and about 25 tons are sold in the adjoining counties."

Juniata forge was built at Petersburg about 1804 by Samuel Fahnestock and George Shoenberger, the latter succeeding to the entire ownership in 1805. Coleraine forges, on Spruce creek, were built in 1805 and 1809, by Samuel Marshall, an Irishman. There have been many forges on Spruce creek, none of which are now in operation. Union furnace, in Morris township, in Huntingdon county, was built by Edward B. Dorsey and Caleb Evans in 1810 or 1811. Pennsylvania furnace, in the northern part of Huntingdon county, was built by John Lyon, Jacob Haldeman, and William Wallace in 1813. It was for a long time managed by John Anderson. The boundary line between Huntingdon and Centre counties ran through this furnace. About 1818 Reuben Trexler, of Berks county, built a bloomary called Mary Ann, in Trough Creek valley, Huntingdon county, and about 1821 he added a furnace with the same name, but afterwards changed to Paradise. In 1832 John Savage, of Philadelphia, built a forge near Paradise furnace, which Hon. Archibald McAllister informs us was the first forge in this country "that used the big hammer and iron helve on the English plan."

George Shoenberger, the father of Doctor Peter Shoenberger, was born in Lancaster county, and during the closing years of the last century settled on Shaver's creek, in Huntingdon county, as did also his brother Peter. The town of Petersburg was laid out in 1795 by Peter Shoenberger, the brother of George Shoenberger. September 27, 1800, Peter sold to his brother George the tract of land of which Petersburg formed a part, and about 1804 George built Juniata forge in connection with Samuel Fahnestock, as we have already stated. Subsequently, as we have shown, he became part owner of Huntingdon furnace. He died in 1814 or 1815. His only son, Doctor Peter Shoenberger, succeeded him in the ownership of his iron enterprises.

Etna furnace and forge in Huntingdon county, now in Catharine

township, Blair county, were built in 1805 by Canan, Stewart & Moore. John Canan was an Irishman from Donegal, but a citizen of Franklin county prior to his emigration to Huntingdon county. The furnace was the first within the limits of the present county of Blair. Cove forge, on the Frankstown branch of the Juniata, in Blair county, two miles northeast of Williamsburg, was built in 1810, by John Royer, who was born in Franklin county in 1779, was a clerk at Chambers's ironworks in that county, was subsequently engaged at Logan furnace, and in 1808 commenced to build Cove forge. After a checkered experience, including an honorable record as a member of the lower branch of the State Legislature, first from Huntingdon and afterwards from Cambria county, he died at Johnstown in 1850. Allegheny furnace was built in 1811, by Allison & Henderson, and was the second furnace in Blair county. In 1835 it was purchased by Elias Baker and Roland Diller, of Lancaster county. The next furnace in Blair county was Springfield, built in 1815 by John Royer and his brother Daniel. Springfield furnace and Cove forge are now owned by John Royer, son of Daniel. The next furnace in this county was Rebecca, built in 1817. The last was the first furnace erected by Doctor Peter Shoenberger, who afterwards became the most prominent ironmaster in the State. Other iron enterprises of his in the Juniata valley were numerous and extensive, and their beginning followed closely upon the building of Rebecca furnace. He also owned ironworks in Bedford, Cambria, Indiana, Westmoreland, Lancaster, Mercer, Allegheny, and perhaps some other counties of Pennsylvania, and at Wheeling in West Virginia. The Doctor was born at Manheim, Lancaster county, in 1781; died at Marietta, Lancaster county, June 18, 1854, aged seventy-three years; and was buried at Laurel Hill cemetery, Philadelphia. His widow is still living at Germantown, at the age of ninety years. He left a large number of children, who continued most of his iron enterprises.

A furnace and forge were built at Hopewell, in Bedford county, about the year 1800, by William Lane, of Lancaster county. On Yellow creek, two miles from Hopewell, Mr. Lane built Lemnos forge and slitting-mill in 1806. In 1841 Loy & Patterson built Lemnos furnace, on Yellow creek, two miles west of Hopewell, to use charcoal, the firm leasing the lands from Mr. Lane. They blew the furnace for a few years, when the property was sold, Messrs. Karns, Horton & Gates purchasing it. They afterwards sold to

John and Thomas King. It has since changed hands several times, and the furnace is now abandoned. Bedford forge, also on Yellow creek, was built by Swope & King in 1812. Elizabeth furnace, now Bloomfield, was built at Woodbury, in Bedford county, in 1827, by King, Swope & Co., Doctor Shoenberger being the company, and owning one-half. In 1845 the furnace was removed to Bloomfield, in Bedford county. In 1840 Bedford county, which then embraced Fulton county and a part of Blair county, contained nine furnaces and two forges. There are now no iron enterprises in Fulton county. There are three modern-built furnaces in Bedford county—one at Hopewell and two at Riddlesburg. Hanover furnace and forge, nine miles below M'Connellsburg, in the Great Cove, in Fulton county, were built fifty years ago—the forge in 1822 by John Doyle, and the furnace in 1827 by John Irvine. The "Hanover ironworks" were regarded in their day as an extensive enterprise. They were abandoned, with many other iron enterprises in the State, soon after the passage of the tariff of 1846. We are favored by James Pott, Esq., of M'Connellsburg, with the following account of Hanover ironworks, which we publish partly to illustrate the varying vicissitudes which the iron industry of Pennsylvania has experienced in the past, and is even now experiencing. No other business appears to be subject to so many vicissitudes as the making of iron.

These works were located in Ayr township, known as the Great Cove, Bedford (now Fulton) county, at a point nine miles southward of M'Connellsburg. The works were commenced in 1822 by John Doyle, who had been previously, and was then, I believe, engaged in the iron business at Mount Pleasant (now Richmond) ironworks, near Loudon, Franklin county, Pa. Mr. Doyle built a forge only, which he operated but for a short time, and was succeeded by Thomas B. Dunn, who carried on the business until 1824, when the property was sold to John Irvine. In 1827 Mr. Irvine built a furnace. Up to this time the pig iron to supply the forge was obtained from Mount Pleasant furnace. The iron business seems then to have been brisk, and in 1831 Mr. Irvine built another forge, and with the furnace and two forges he carried on a lively business, manufacturing wrought iron and stoves and hollow ware, employing, off and on, from seventy-five to one hundred and fifty hands. Mr. Irvine operated the works with varying success until 1833, when he "suspended," and James E. Turner and Samuel Van Tries purchased the property and operated it extensively until 1836, when Mr. Turner withdrew from the firm, Mr. Van Tries becoming the sole proprietor, but soon after associating with himself James B. Ross in the business. Under the new firm the works were operated profitably and successfully for a while, but under the disastrous effects of the "compromise tariff" of 1833 the iron business languished and

the firm failed in 1842. The property then reverted to William Pott, an ironmaster at Loudon, Franklin county, Pa., as it had done on each similar preceding occasion, he being the mortgagee in the case. Mr. Pott then leased the works to James E. Turner, (the former associate of Mr. Van Tries,) in 1843. Mr. Turner operated on a limited scale, using the forges only, making blooms, mainly from the iron in the mass of accumulated forge cinders of the preceding years. In September, 1843, the works were almost entirely destroyed by the great freshet of that time, and Mr. Turner did little after that in the iron business.

William Pott now sold his Hanover ironworks property to John Pott, formerly owner and operator of the Greenwood ironworks at Pottsville, Pa., and afterwards of Manheim ironworks, on the West Branch of the Schuylkill, where the town of Cressona now stands. Encouraged by the revival of the iron business by the stimulus given it by the protective tariff of 1842, Mr. Pott took possession of these works in April, 1844, and at once set to work repairing the damages of the freshet of 1843. He built a new furnace, which was put into operation in the fall of 1844. The iron business was then remunerative, and promised prosperity by reason of the vitality given it by the tariff of 1842. The tariff of 1846 followed and worked disaster to the iron business of Pennsylvania, and in 1847 Mr. Pott made the last blast in Hanover furnace, abandoned the manufacture of iron, built a mill on the site of one of the forges, and thenceforth devoted himself to agriculture and milling. This was the end of Hanover ironworks, and nothing now remains to indicate its former character except the stack of the furnace and the huge piles of slag and cinders which bear evidence of the extent of the business during the period between the years 1822 and 1847. Mr. Pott died in 1856, but the property still remains in the hands of his family. The capacity of the respective furnaces was not large, being from fifteen to twenty tons of pig iron per week, with cold blast and water-power.

Steel was made at Caledonia, near Bedford, for several years before the beginning of this century. A circumstantinl and very interesting account of this enterprise is given in the following extract from a letter addressed to James Park, Jr., of Pittsburgh, by a distinguished citizen of Pennsylvania. The facts given in this extract are now for the first time printed.

William McDermett, who was born near Glasgow, Scotland, emigrated to this country at the close of the Revolutionary war, say about 1783-84. He married in England and brought his young wife with him. He possessed a small capital. She was highly educated and accomplished. I have seen some of the jewels, silver plate, and clothing which she brought with her. They would indicate that her family were persons of some consideration. The young couple landed at Philadelphia, and proceeded westward through Pennsylvania. He had, in Scotland, learned the art of making steel by some new process, and believed the ores of Pennsylvania to be favorable to his project. He went as far west as Bedford, attracted possibly by the name of the place,

which was well known to his wife in England. Going a short distance nearly south of that town, and about a mile beyond the present Bedford Springs, he seems to have found the location he was in search of, and there commenced his work, having given to it the name of "Caledonia," by which it is yet known to the residents of Bedford. He erected a log dwelling-house, constructed an extensive dam, and put up his machinery in a humble way. In a few years he began to manufacture steel very successfully. It was sent by his teams to the neighboring counties, and articles of merchandise brought back in return. Many of his children, with whom I have conversed, remember handling the small bars of steel, seeing the departure of the teams, and greeting them on their return. This continued for eight or ten years. At about the close of the last century, when the family lived very comfortably and their means were increasing, Mr. McDermett indorsed for one or more of his neighbors who were in trouble. His fate was the common result of such benevolence. The sheriff soon sold the establishment. Much of the farming land now occupied by the proprietors of the Springs belonged to Mr. McDermett, and the patents from the Commonwealth are found in his name. No other person seems to have understood the art which he had thus successfully put into practice. The house in which he lived still stands. The apple orchard which he planted continues to bear some fruit; but his machinery and works were gradually carried away and converted to other uses. A large part of the dam yet remains, but those who annually fish in it for trout know little of the enterprising man who built it. He moved with his family into the village of Bedford, and lived for a few years in the stone house which stands on one of the corners of the public square. When General Washington passed through Pennsylvania he rested at Bedford, and was the guest of Mr. McDermett and his family. Several of the children were in the habit of repeating the pleasant things which the General said to them during his visit. A few years later Mr. McDermett moved to Spruce creek, in Huntingdon county, on which a considerable iron business had sprung up. Here he ended his days. His wife survived him for many years, and her children experienced all the benefits of the liberal education which her acquirements enabled her to impart to them. While she resided on Spruce creek, a young lawyer named David R. Porter came there to learn the business of making iron. He had studied his profession in Lancaster and Harrisburg, but was prevented from practicing it by successive hemorrhages of the lungs. He was soon employed by the Dorseys as the manager of their works, and afterwards for many years exerted a large influence as a State Senator of Pennsylvania and as Governor of the Commonwealth. He married one of the daughters of Mr. McDermett. In old age Governor Porter was, perhaps, as well informed in regard to the progress of the iron business in Pennsylvania as any other citizen of the State. He always regarded Mr. McDermett as the chief pioneer in the manufacture of steel, and greatly regretted that he had not, in his lifetime, committed the process to the keeping of some other person.

To the above we are enabled to add some additional particulars concerning both Mr. McDermett and his distinguished son-in-law.

After Mr. McDermett's removal to Spruce creek, a forge and steel works, called Claubaugh, were built on the creek by his nephew, Thomas McDermett, at which steel was made by the process that was used at Caledonia. We presume that blister and shear steel were made by this process. These works passed into the hands of Lloyd, Steel & Co. about the time of the death of William McDermett in 1819 or 1820, by whom they were conducted for a few years, when they were permanently abandoned.

David R. Porter was first employed for one year as a clerk at Barree forge, and during the following year he was employed as manager. He next entered into partnership with Edward B. Patton in the building of Sligo forge, on Spruce creek, which establishment passed out of their hands in 1819, in which year Mr. Porter was elected to the lower branch of the Legislature from Huntingdon county, from which event his successful political career may be dated. In 1820 he married Josephine McDermett, a lady of rare attainments.

Many other furnaces and forges and a few rolling-mills were built in the upper part of Juniata valley after 1800. In 1832 there were in Huntingdon county, which then embraced Blair, eight furnaces, ten forges, and one slitting and rolling mill in operation. Each of the furnaces yielded from 1200 to 1600 tons of metal annually. In the same year an incomplete list enumerated eight furnaces and as many forges in Centre county. For many years after the beginning of this century Huntingdon and Centre counties constituted the principal iron-producing district in the country, Pittsburgh and Eastern cities manufacturing the iron which they supplied. This prominence in the production of iron was maintained until after 1842, when the tariff of that year and the discovery that iron could be made with anthracite and bituminous coal enabled other districts in the State and country to wrest from these counties their iron sceptre. In 1850 there were in these two counties and in Blair county (formed out of Huntingdon and Bedford in 1846) and in Mifflin county forty-eight furnaces, forty-two forges, and eight rolling-mills, nearly all of which were in Huntingdon and Centre. These two counties have a long and most honorable iron record.

There was a very early forge in Mifflin county, the site of which is now in Juniata county. The following account of it is condensed from a letter we have received from A. L. Guss, Esq., a native of Juniata county.

Between 1794 and 1800 a forge was built on Licking creek, about a mile and a half west of Mifflintown, then in Mifflin but now in Juniata county, by William Sterrett and Thomas Beale. Sterrett was the son of an Indian trader, and was the first white male child born within the present limits of Juniata county, being born in Bingham Fort. Beale was a son of William Beale who settled at Tuscarora Academy in 1754, and who came from East Caln, Chester county. The forge was in operation for about four years. Some of the pig iron for this forge was brought from Lancaster county, but most of it came from Centre county. The supply from the latter county was hauled across Seven mountains and loaded on arks at Lewistown and floated down the Juniata to the place now known as Patterson, opposite Mifflintown, and thence hauled to the forge. One of these arks suffered shipwreck above the head of "the island." Much of the pig iron with which it was loaded was recovered by the farmers and used as andirons in their houses, and in lime-kilns to hold up the wood. In 1806 the forge was destroyed by fire. Its remains may be seen at this day.

Hope furnace, six miles from Lewistown, and Freedom forge, three miles from the same place, were built in 1810, and were probably the first iron enterprises within the present limits of Mifflin county. General James Lewis was one of the proprietors of Hope furnace. In 1832 there were three furnaces and one forge in Mifflin county, and in 1850 there were five furnaces and two forges.

The first iron enterprise in Perry county was probably a forge on Cocalamus creek, built in 1807 or 1808 by General Lewis, and operated by him in connection with Hope furnace. It was abandoned about 1817. It had two fires and two hammers, and was called Mount Vernon. Juniata furnace, three miles from Newport, was built in 1808 by David Watts, Esq., an eminent lawyer of Carlisle. In 1832 it was owned by Capt. William Power. A forge called Fio was built on Sherman's creek, about four miles from Duncannon, in Perry county, in 1829, by Lindley & Speek. A forge was built at Duncannon in 1829 by Stephen Duncan and John D. Mahon. Duncannon rolling-mill was built in 1838 by Fisher, Morgan & Co. Montebello furnace, at Duncannon, was built in 1834; Perry furnace, four miles from Bloomfield, in 1840; Oak Grove, four miles from Landisburg, by Dr. Adam Hayes and his brother John, in 1830; and Caroline, at Bailysburg, in 1833. These furnaces were built to use charcoal, and all have been abandoned. There are several new anthracite furnaces in this county, but nearly every one of them is now idle.

Elizabeth furnace, near Antestown, in Blair county, is said to have been the first in the country to use gas from the tunnel-head for the production of steam. The furnace was built in 1832,

and the gas was first used in 1836. The improvement was patented in 1840, and as late as 1846 the owner of the furnace, Martin Bell, charged other furnaces a royalty for the right to use the gas.

Among the names which have been prominent in the iron manufacture in the Juniata valley, special reference may be made, in addition to Doctor Shoenberger and others who have been mentioned, to Henry S. Spang of Lancaster county, John Lyon of Cumberland county, and Anthony Shorb of Lebanon county.

Early Ironworks in other Central and Eastern Counties.—In Clearfield, Clinton, and Tioga counties a few furnaces have been built since 1811, when Washington furnace, on Fishing creek, at Lamar, Clinton county, was built. It was in blast in 1875. But nearly every other iron enterprise in these counties has proved to be a financial failure. The furnace at Farrandsville, near the mouth of Lick run, in Clinton county, which was built about 1834, to use coke, sunk, in connection with a nail-mill, foundry, and other enterprises, a large sum of money, said to be over half a million dollars, contributed by Boston capitalists, William P. Farrand, of Philadelphia, being their agent. Mill Hall furnace, near the mouth of Fishing creek, in this county, was built in 1831, by George Bressler, in company with Messrs. Harvey, Wilson, and Kinney, to use charcoal. In 1857 it was converted into an anthracite furnace. Sugar Valley furnace, at Logansville, in Clinton county, was built in 1834, and Washington forge, in the same county, in 1837. Lamar furnace, at Salona, in the same county, was built in 1831. Of the enterprises above named, Washington furnace and forge are the only ones that have not been abandoned. In a sketch of Clearfield county, in Egle's *History of Pennsylvania*, it is stated that "in 1814 Peter Karthaus, a native of Hamburg, Germany, but afterwards a resident merchant of Baltimore, established a furnace at the mouth of the Little Moshannon, or Mosquito creek, in the lower end of the county." This furnace was operated with partial success for several years. Between 1834 and 1837 it was converted into a coke furnace, but was soon afterwards abandoned. The first furnace in Tioga county was built at Blossburg to use charcoal, but in 1841 it was altered by J G. Boyd and another person to use coke. It soon chilled, however, and was abandoned.

An early furnace in Lycoming county was built in 1820, four miles from Jersey Shore, and named Pine Creek. In 1832 it

was owned by Kirk, Kelton & Co. A forge was added at the same place in 1831. Heshbon forge, furnace, and rolling-mill, on Lycoming creek, five miles above its mouth, were built, respectively, in 1828, 1838, and 1842. Hepburn forge, on the same creek, twelve miles north of Williamsport, was built in 1830, and Crescent rolling-mill, one mile lower down the stream, was built in 1842. About 1835 Astonville furnace, near Ralston, was built to use coke, but charcoal was soon substituted. At Ralston a charcoal furnace, rolling-mill, nail factory, etc., were erected by the Lycoming Valley Iron Company in 1837. In 1850 there were three furnaces, three forges, and two rolling-mills in this county.

Esther furnace, about three miles south of Catawissa, on East Roaring creek, in Columbia county, was built in 1802 by Michael Bitter & Son, who cast a great many stoves. In 1836 the furnace was rebuilt by Trago & Thomas. Catawissa furnace, on Furnace run, near Mainville, in Columbia county, was built in 1815, and a forge was built at the same place in 1824, on Catawissa creek. In 1832 there were two furnaces and two forges in Catawissa township. In 1837 Briar Creek furnace, two miles from Berwick, in Columbia county, was built. It has not been in blast since 1849. In 1845 Fincher & Thomas built Penn charcoal furnace, on Catawissa creek, one mile east of Catawissa. All these furnaces have been abandoned, but the forge at Mainville is still active. The Irondale anthracite furnaces, two stacks, were built at Bloomsburg in 1844 and 1845. Bloom furnace, to use anthracite, was built on the North Branch canal, near Bloomsburg, by William McKelvy, William Neal, and Jacob Melick in 1853, and put in blast April 14, 1854. A charcoal furnace, called Liberty, was built at Mooresburg, in Montour county, in 1838. The first furnace at Danville, in Montour county, was built in 1838 to use charcoal, but was altered to use anthracite the following year, when two other furnaces were built to use the new fuel, followed in 1840 by a fourth, and soon after by others. Danville rolling-mill was built in 1845, Montour in 1845, and Rough-and-Ready in 1847—all at Danville.

A furnace and forge were in operation in Shamokin township, Northumberland county, as early as 1830, probably Paxinas. A furnace was built at Shamokin in 1841 to use anthracite. It was followed by Chulasky furnace in 1846, also anthracite. A furnace and forge were built near Hartleytown, in Union county, in 1827, and called Berlin. They were followed by Forest, near

Milton, in 1846, and Beaver, near Middleburg, in 1848—both charcoal furnaces. Union furnace, to use anthracite, was built in 1854 at Winfield, Union county, by Beaver, Geddes, Marsh & Co.

Nescopeck forge, near Berwick, in Luzerne county, was built in 1824, and abandoned about 1854. Shickshinny charcoal furnace was built in 1846. In 1811 Francis McShane established a small cut-nail manufactory in Wilkesbarre, "and used anthracite coal in smelting the iron." The first rolling-mill in this county was Wyoming, at Wilkesbarre, built in 1842, and followed by Lackawanna, at Scranton, in 1844. Wyoming was abandoned about 1850. Luzerne is now one of the most prominent iron counties in the State. It owes most of this prominence to the courage, energy, and business sagacity of two brothers, George W. and Selden T. Scranton, and their cousin, Joseph H. Scranton. One of the five furnaces of the Lackawanna Iron and Coal Company at Scranton, in the organization of which they were the leading spirits, is the widest in the State—23 feet at the bosh, and another was the highest in the State—80 feet, but now reduced to 70 feet.

A forge was built at Stroudsburg, in Monroe county, in 1829, called Analomink. In 1843 Day styled it a "large forge."

There is some obscurity concerning the early iron enterprises of Dauphin county, arising partly from its connection with Lancaster county down to 1785 and with Lebanon county down to 1813, rendering it difficult to separate the enterprises of Dauphin county from those of the other counties. Iron was doubtless made within its limits as early as 1800, and probably by members of the Grubb family. Henry Fulton established a "nailery" in Dauphin county in 1785, probably at Harrisburg. It is said to have been "only a little remote from a smithy." Lesley describes Mount Vernon furnace, built in 1800, and a forge of the same name, on the Conewago river, "on the borders of Dauphin county." In 1805 there were two furnaces and two forges in the county. Oakdale forge, at Elizabethville, appears to have been built in 1830. Victoria furnace, on Clark's creek, was built in 1830. Gordon, in his *Gazetteer of Pennsylvania*, says there were three forges and two furnaces in the county in 1832. Emeline furnace, at Dauphin, was built about 1835. The first furnace at Middletown in this county was built in 1833, and a second furnace was built in 1849, both cold-blast charcoal. Manada furnace, at West Hanover, was built in 1837 by E. B. & C. B. Grubb. The first rolling-mill in the county was the old Harrisburg mill, at Harrisburg, built in 1836. Fair-

view rolling-mill, on the Cumberland side of the Susquehanna, two miles above Harrisburg, was built in 1831. The first anthracite furnace in the county was built at Harrisburg in 1845 by Governor David R. Porter. Hon. Simon Cameron has been prominently identified with the iron interest of this county. The Pennsylvania steel works, the first Bessemer steel enterprise in the State, are in this county. They went into operation in 1867.

Chestnut Grove furnace, at Whitestown, in Adams county, was built in 1830. About 1830 there was a furnace in this county named Maria, owned by Stevens & Paxton (Thaddeus Stevens).

Schuylkill county has had several forges, mainly at or near Port Clinton, the first of which at that place appears to have been built in 1801. In 1800 Messrs. Reese & Thomas made preparations toward building a furnace and forge where Pottsville now stands. Prior to 1804 a small charcoal furnace was built by them at this place. In 1807 Greenwood furnace and forge were erected at Pottsville by John Pott, the founder of the town, which was laid out in 1816. In 1832 Gordon gave the ironworks then in operation in Schuylkill county as follows: Greenwood furnace and forge, and Schuylkill, Brunswick, Pine Grove, Mahanoy, and Swatara forges. A furnace called Swatara, six miles from Pine Grove, was built in 1830, which was followed by Stanhope furnace, still nearer to Pine Grove, in 1835. Other iron enterprises have since been established in this county.

First Ironworks West of the Alleghenies.—The first iron manufactured west of the Allegheny mountains was made in Fayette county, Pennsylvania. F. H. Oliphant, of Uniontown, awards to John Hayden, of Fayette county, the honor of having made "the first iron in a smith's fire" as early as 1790. Taking a sample on horseback to Philadelphia, he enlisted John Nicholson of that city in a scheme for building Fairfield furnace, seven miles south of Uniontown, on George's creek, and the two "then went on to build the furnace." Mr. Oliphant thinks this was the first furnace, the date of the erection of which he fixes at "about 1790," but Bishop says that the first furnace "was built by Turnbull & Marmie, of Philadelphia, on Jacob's creek, between Fayette and Westmoreland counties, fifteen miles above its entrance into the Youghiogheny river. It was first blown in November 1, 1790, and produced a superior quality of metal both for castings and bar iron, some of it having been tried the same day in a forge

which the proprietors had erected at the place." The date given here is correct, but the location given to the furnace is erroneous. Craig, in his *History of Pittsburgh*, (1851,) gives currency to the error in locating this furnace. It was built two and a half miles above the mouth of Jacob's creek, on the Fayette bank, and called the Alliance iron works. The stack is still standing, but in ruins. The furnace was successfully operated for many years. John Holkar, the French naval agent at Philadelphia, was a silent partner with Turnbull & Marmie. The firm was dissolved August 22, 1793, Peter Marmie taking the works on Jacob's creek, and William Turnbull retiring. Craig gives an extract from a letter by Major Craig, Deputy Q. M. General and Military Storekeeper at Fort Pitt, to General Knox, dated January 12, 1792, as follows: "As there is no six-pound shot here, I have taken the liberty to engage four hundred at Turnbull & Marmie's furnace, which is now in blast."

Mr. Oliphant says:—"I find by my father's books that he and his brother Andrew (John and Andrew Oliphant) bought a half interest in Fairfield in 1795, the parties carrying it on six months alternately for a few years. It then fell into the hands of J. & A. Oliphant." This proves that the furnace was built before 1795. Hon. James Veech says that it was built in 1792.

On the 29th of March, 1871, Mr. Veech published in the Pittsburgh *Commercial* a communication concerning early ironmaking in Fayette county, from which we quote the following notice of the pioneer, John Hayden:

In the spring of 1789, John Hayden, who had lived in the red-ore iron region of New Jersey, hauled over the mountains, from Hagerstown to Brownsville, Fayette county, a four-horse wagon load of goods for Jacob Bowman, who had come from the former to the latter place in 1787, at which he was a prominent merchant and citizen for half a century. Hayden was nearly a month in making the trip—hauling 2,100 pounds at $3 per hundred. Pleased with the beautiful valley at the western base of the Laurel Hill Mountain—the last of the chain south of the Youghiogheny, and tired of teaming, he resolved to settle in "the West," and at once removed to near Uniontown. He soon bought out a settler near to where is now "Fairchance Oliphant's) ironworks," and fixed his abode upon it in the spring of 1790. On the land was a log dwelling, not yet chunked and daubed; and as winter approached, Hayden betook himself to stopping the interstices. For this he must needs have mortar, which, he thought, could not be well made without lime or calcined oyster or clam shells. As the latter could not be had, he looked around for limestone. In gathering what he supposed were limestones from the bed of a stream, he gathered—unwittingly—"blue lump" iron ore, so

unlike the Jersey ores that he never suspected the cheat. He made up a pile of it to burn, with wood, and, after supposing it well burnt, plunged lump after lump of it into water and found it wouldn't *slick*, and that it was as heavy as when he took it from the run. Coming to the conjecture that it was some new form—or color—of iron ore, he resolved to test it. The expedient was an improvised furnace upon a blacksmith's hearth; but none of the smiths in the neighborhood would entertain the experiment. Having a Jersey acquaintance, a smith, in the vicinity of Connellsville, he had resort to him. He had faith enough in the blue lumps to allow the experiment on his hearth. After long and repeated efforts at heating and hammering, the result was a piece of iron, as Hayden used to say, "about as big as a harrow-tooth." Elated with his discovery, Hayden put his "harrow-tooth" and some of the ore in his saddle-bags and rode off to New Jersey, to enlist some of his iron acquaintances in the project of building a furnace and forge in Fayette. None of them would join him in the enterprise. He came back to Philadelphia, where, after his discovery became known, he succeeded in securing the favor of the celebrated John Nicholson, then State Comptroller, and in the zenith of his fame and speculations, which were ultimately so disastrous to himself and the finances of the Commonwealth. Nicholson soon after joined him, and thereupon "took up" large tracts of land in and near the base of Laurel Hill, embracing the territory of Hayden's "blue lump" discoveries. Hayden, about 1792, with the aid of Nicholson, built a little furnace called Fairfield, near to where is now Fairchance; but his patron went down and John Hayden followed; and in a few years the father of F. H. Oliphant succeeded to his furnace and possessions. It may be set down as certain that John Hayden, in 1790, made the first iron west of the mountains. But his furnace was not in operation until after others, profiting by his discovery, had built furnaces and begun the manufacture of *castings*.

Union furnace, now Dunbar furnace, was built by Colonel Isaac Meason, on Dunbar creek, four miles south of Connellsville, in 1791. The tradition is preserved that Union furnace was put in blast in March, 1791. We have already stated that Turnbull & Marmie's furnace was put in blast in November, 1790. Union furnace was succeeded in 1793 by another and a larger furnace of the same name, built near the same site by Colonel Meason and Moses Dillon. Another early furnace was Fairchance, six miles south of Uniontown, on George's creek, built by John Hayden, William Squire, and Thomas Wynn in 1794. J. & A. Oliphant bought it in a dilapidated condition about 1805. It was rebuilt two or three times, and kept in operation until 1873. A forge was built near the furnace about 1794. Another of Colonel Meason's enterprises was Mount Vernon furnace, on Mountz's creek, eight miles east of its mouth, built before July, 1800, as appears from an old advertisement. In 1801 it was rebuilt, as appears from an

inscription which is yet preserved. The stack was built of large blocks of sandstone, and is still standing. It is thirty-three feet high and eight feet wide at the bosh. The furnace was last operated in 1824. Laurel furnace, on Laurel run, near Union furnace, was built by Mockbee & Wurts before 1800, and subsequently rebuilt by James Paull on another site. The firm named also built Hampton forge, to work up the pig metal of Laurel furnace. In May, 1800, John Ferrel, manager, advertised for sale castings, "neat, light, and tough," at $100 a ton; also bar iron. He expected soon to have "some rolled iron, nail rods, and cut nails," the latter at eight cents a pound. Redstone furnace, three miles east of Uniontown, was built in 1800. Joseph Huston was one of its first owners, and was followed by his nephew, Judge John Huston, and afterwards by John Snyder. A forge on the head waters of George's creek was owned by Thomas Lewis and Philip Jenkins in 1800, when it was advertised for sale by the sheriff. Spring Hill furnace was built in 1805 by Robert Jones, and afterwards fell into the hands of Jesse Evans. Mary Ann furnace, nine miles from Uniontown, was built by Richard Lewis in 1800, and in 1818 was bought by the present owner, Joseph Victor, who lived on the premises in 1877, at the age of about 90 years. He rebuilt or repaired the furnace, and changed its name to Fairview.

Other furnaces were built in Fayette county early in the present century, among them the following: Pine Grove, eleven miles from Uniontown, built about 1805, and owned in 1857 by Basil Brownfield; Mount Etna, one and a half miles above Connellsville; Centre, nine miles from Uniontown, on Dunbar creek; Fayette, twelve miles from Connellsville; Little Falls, twelve miles from Uniontown, by Nathaniel Gibson; St. John's, built by James Paull, eight miles from Connellsville. There was a forge at Little Falls as early as 1809. Breakneck or Findley furnace was built about 1826, four miles northeast of Connellsville. In 1805 there were five furnaces and six forges in Fayette county. In 1811 there were ten blast furnaces, one air furnace, eight forges, three rolling and slitting mills; one steel furnace, and five trip-hammers. The steel furnace was owned by Morris Truman & Co., at Bridgeport, adjoining Brownsville, and made good steel. In 1816 Colonel Isaac Meason built a mill for puddling iron and rolling bars at Plumsock, in this county, of which we shall speak hereafter.

It will be seen that Fayette county was a great iron centre at the close of the last and the beginning of the present century.

For many years Pittsburgh and the Ohio and Mississippi valleys were almost entirely supplied by it with castings of all kinds, and with pig and bar iron. Long before 1850, however, the fires in most of its furnaces and forges were suffered to die out. In 1849 only four of its furnaces made iron. In 1876 the county contained five furnaces and one rolling-mill.

A furnace named Mary Ann was erected at a very early day about twenty miles from Uniontown, in Greene county, on the opposite side of Ten Mile creek from Clarksville. It was abandoned long before 1820. Hon. James Veech writes us that he remembers the ruins of it well. The stack was visible for some time after 1840. He has an advertisement by "Samuel Harper, agent for the proprietors," dated July 23, 1810, for its sale, naming it as "The Iron Works," late the property of Captain James Robinson. It was probably built about 1800. Gordon, in his *Gazetteer*, (1832,) says that "there were formerly in operation on Ten-Mile creek a forge and furnace, but they have been long idle and are falling to decay." Day, in his *Historical Collections*, (1843,) says "a forge and furnace were formerly in operation near the mouth of Ten-Mile creek, but were suffered to decline." These references are clearly to Robinson's works. We think that Greene county has never had any other iron enterprise within its limits.

From 1790 to 1800 it is probable that twenty furnaces were built in Pennsylvania. One of these was located within about three miles of Pittsburgh, near the present suburb of Shady Side. It was soon abandoned. We shall refer to it farther on. The first nail factory west of the Alleghenies was built at Brownsville, before 1800, by Jacob Bowman, at which wrought nails, made by hand, were produced in large quantities.

Description of the Primitive Method of Manufacturing Wrought Iron.—From a letter received by us from Mr. Oliphant we quote an interesting description of the early method of manufacturing wrought iron from the ore in Western Pennsylvania. It is the same that was in use at an earlier day in other sections of the State.

The first wrought iron made west of the Alleghenies was by blooming the ore from the Fairfield mines, blue lump, by Mr. John Hayden, one of the proprietors of Fairfield furnace. The process was to burn the ore and then pulverize it by stamping very fine. Then it was placed in an open fire, 18 inches square by 15 inches deep, formed of stone, having a tuyere 5 inches

below the top, one inch in diameter, supplied by blast from tubs, and water-wheel to drive the tubs, making a half pound to the inch: fuel, charcoal. Work commenced by filling the open fire with charcoal; when lighted up fully applying the blast in the tuyere; then applying the pulverized ore with a shovel by putting it on slowly above the blast, and as it melted the iron ran down below the blast, the cinder being drawn off, and when the space below the blast was filled up to the tuyere, being in a solid mass, it was raised out by a bar 100 lbs. in weight, and taken to a hammer weighing 500 lbs., driven by a water-wheel at the rate of from fifty to two hundred strokes per minute. The chunk was hammered into a bloom; then one end was heated in the same fire to a welding heat, and drawn into what was called an anchony. When some twenty or thirty of these were made, they then enlarged the fire to 20 inches square and 20 inches deep, and heated the bloom or large end, and drew it out under the hammer into bars of various lengths, from five to ten feet long, and various widths and thicknesses, ready for market.

When the furnaces were got under way, and pig metal was being made, old-fashioned Dutch fires were made to work the pig metal into anchonies, and draw it out into bars. Some ten or twelve of these forges were built up through the county by the persons owning the furnaces, J. & A. Oliphant putting up the first two on George's creek, six miles below the furnaces, and called Sylvan forges. These forges were all built alike, four fires each, three for making the anchonies and one a chaffery to draw them out into bars.

All the furnaces and forges dropped off one by one until all were stopped in the county, except Fairchance and Redstone, the latter going occasionally from 1832 up to 1856. Fairchance, building a rolling-mill in 1834, supplied this whole section with iron, nails, etc., for twenty years, the only ironworks in constant operation. Fairchance built the rolling-mill, making all the machinery castings out of the furnace iron, even the large fly-wheels. The steam cylinder and blast cylinder were brought from abroad.

The First Rolling-Mills West of the Alleghenies.—Doubtless rolling and slitting mills, for the manufacture of nail rods principally, were established west of the Alleghenies soon after the first furnace and forge were built in 1790, but specific information concerning the first ventures of this kind is wanting. Cramer's *Pittsburgh Almanac* for 1812 says that in 1811 there were three such mills in Fayette county. The first rolling-mill of any kind west of the Allegheny mountains of which we can obtain exact information is described in the *Almanac* for 1813, issued in 1812, as follows: "Jackson & Updegraff, on Cheat river, have in operation a furnace, forge, rolling and slitting mill, and nail factory—nails handsome, iron tough." Like all the rolling and slitting mills of that day and of many preceding days, the Cheat river mill neither puddled iron nor rolled bar iron, but rolled only sheet iron and nail plates with plain rolls

from blooms heated in a hollow fire and hammered under a tilt-hammer. The nail plates were slit into nail rods by a series of revolving disks. In reference to the Cheat river enterprise, Mr. Veech writes us that its location was in West Virginia, on the road from Uniontown to Morgantown, about three miles south of the Pennsylvania State line, and eight miles north of Morgantown.

The honor of having erected the first rolling-mill at Pittsburgh is undoubtedly due to Christopher Cowan, an Englishman, who built a mill here in 1812. But this mill had no puddling furnaces, nor was it built to roll bar iron. It was intended to and certainly did manufacture sheet iron, nail and spike rods, shovels, spades, etc. The same number of the *Pittsburgh Almanac* from which we have last quoted says of this enterprise: "Christopher Cowan is erecting a powerful steam-engine, 70 horse-power, to run a rolling-mill, slitting-mill, and tilt hammer; to make iron, nails, sheet iron, spike and nail rods, shovels and tongs, spades, scythes, sickles, hoes, axes, frying pans, cutting knives, chains, plough irons, hatchets, claw hammers, chizzels, augurs, spinning-wheel irons, and smiths' vises—capital $100,000."

The first rolling-mill erected west of the Alleghenies to puddle iron and roll iron bars was built in 1816 and 1817 on Redstone creek, about midway between Connellsville and Brownsville, at a place called Middletown, better known as Plumsock, in Fayette county. The enterprise was undertaken by Colonel Isaac Meason, of Union furnace, who had forges at Plumsock. Thomas C. Lewis was chief engineer in the erection of the mill, and George Lewis, his brother, was turner and roller. They were Welshmen. The project was conceived by Thomas C. Lewis, and by him presented to Colonel Meason. This mill was much more complete than Cowan's. Mr. Oliphant tells us that it was built "for making bars of all sizes and hoops for cutting into nails." He says further that "the iron was refined by blast, and then puddled. It was kept in operation up to 1824, the latter part of the time by Mr. Palmer." A flood in the Redstone caused the partial destruction of the mill, the machinery of which was subsequently taken to Brownsville.

In an interview with Samuel C. Lewis, of Pittsburgh, the son of Thomas C. Lewis, he informs us that his father and his uncle George Lewis not only superintended the erection and put in operation the mill for which these honors are claimed, but that he himself as a boy assisted in rolling the first bar of iron, his

uncle being the chief roller. In addition to Thomas C. and George Lewis, two other brothers participated in the work of starting the mill and in the rolling of the first bar—Samuel Lewis, heater, and James Lewis, catcher. At the same time Henry W. Lewis, another brother, was a clerk in the office. Samuel C. Lewis, our informant, was a boy of fifteen years, and "heaved up" behind the rolls. The mill contained two puddling furnaces, one refinery, one heating furnace, and one tilt-hammer. Raw coal was used in the puddling and heating furnaces and coke in the refinery. James Pratt worked the refinery, and David Adams was the puddler. The mill went into operation in September, 1817. Mr. Lewis tells us that his father and uncle, being skilled workmen, and therefore prohibited by an English statute from leaving their native land, were compelled to smuggle their passage across the Atlantic. He further informs us that his father, before going to Plumsock, unsuccessfully endeavored to induce Eastern ironmasters to introduce puddling furnaces and rolls for bar iron.

Was Plumsock the First Mill to Roll Bars and Puddle Pig Iron?—We think it extremely probable that at this mill was done the first puddling and that here was rolled the first bar iron in America. Careful inquiry in well-informed quarters fails to discover the existence in the United States of any rolling-mill to roll bar iron and puddle pig iron prior to the enterprise at Plumsock in 1816. Ralph Crooker, of the Bay State ironworks, at Boston, the oldest rolling-mill superintendent in the United States, writes us that the first bar iron rolled in New England was rolled at the Boston ironworks, on the Mill Dam in Boston, in 1825, and that the first puddling done in New England was at Boston, on the Mill Dam, by Lyman Ralston & Co., in 1835. We can not learn of any mill in Eastern Pennsylvania that either puddled iron or rolled bars as early as 1816.

We have, however, obtained the curious information that a patent was granted to Clemens Rentgen, of Kimberton, Chester county, Pa., as late as June 27, 1810, for a machine to roll iron in round shapes, proving that Cort's rolls had not then been introduced into the United States. Mr. Rentgen was a native of the Palatinate, (now Bavaria,) in Germany, and emigrated from the town of Zweibrucken in 1791 to Kimberton, about six miles from Phœnixville, where he purchased a forge on French creek. At Knauertown he built steel works, at which he undertook to manufacture

steel. The steel works were, however, not successful. His forge was continued, and to it he added a small rolling-mill. His various enterprises were known as the "Pikeland works," Pikeland being the name of the township in which they were situated. On the 17th day of November, 1796, he obtained a patent for "forging bolts or round iron," which he described as follows:

> This machine consists of a strong platform, of a given size, in which are fixed two upright posts. In these posts is fixed an axle going through the handle of a concave hammer or sledge, at the extreme end of which is fixed a cogwheel, whose cogs, operating on the lever or handle of the said concave hammer or sledge, cause it to operate upon a concave anvil upon which the iron to be wrought is placed. The concavity of this anvil is about one-eighth of the dimensions of that of the said hammer or sledge. This machine is set in motion by water or any other adequate power, by wheels operating upon the said cogwheel.

On the 27th day of June, 1810, Mr. Rentgen obtained a patent, noticed above, for "rolling iron round, for ship bolts and other uses," which he thus described:

> This machine consists of two large iron rollers, fixed in a strong frame. Each roller has concavities turned in them, meeting each other to form perfect round holes, of from half inch to one and three-quarter inches or any other size in diameter, through which rollers the iron is drawn from the mouth of the furnace with great dispatch, and the iron is then manufactured better and more even than it is possible to forge it out. The force applied to the end of these rollers is like that applied to mills.

The original patents of Mr. Rentgen have been shown to us by his descendant, Professor William H. Wahl, of Philadelphia. We learn from this gentleman that Mr. Rentgen made some use of his patent anvil and hammer, and that, before obtaining the patent in 1810 for his method of rolling round iron, he built an experimental set of rolls, which were replaced after the patent was granted by a permanent set, with which he rolled round iron as early as 1812 or 1813, some of which was for the Navy Department of the United States Government. We do not learn that he ever rolled bar iron, and it is not claimed that he used puddling furnaces.

It is a curious fact, which may not be known to many of the present generation of American ironmasters, that pig iron has been puddled in this country with wood, as it is now at some places in Sweden; and by the term wood we do not mean charcoal. Prior to 1850 puddling with wood was done at Horatio Ames's works, at

Falls Village, in Connecticut; and the Katahdin ironworks, in Maine, puddled with wood in that year. From 1821 to 1825 the Fall River rolling-mill, in Massachusetts, used wood in heating iron for nail plates in reverberatory furnaces.

Beginning of the Iron Industry at Pittsburgh.—The iron industry of Pittsburgh, the most important iron centre in the country, did not have an existence in the last century, although a blast furnace was built within a few miles of the town before its close, as already stated. As the site of this blast furnace is now embraced within the city limits, we give place here to a full account of it and of its founder, which we have derived from trustworthy original sources.

George Anshutz, the pioneer in the manufacture of iron at Pittsburgh, was an Alsacian by birth, Alsace at the time being under the control of France. He was born November 28, 1753. He acquired some knowledge of the iron business by having the management of a foundry in the vicinity of Strasburg. In 1789 he emigrated to the United States, and soon afterwards located at a place now known as Shady Side, where he built a small furnace, probably completing it in 1792. In 1794 the furnace was abandoned. It had been expected that ore could be obtained in the vicinity, but the expectation was not realized. The neighborhood produced little else than red shale. Recourse was next had to a deposit of iron ore on Roaring run, an affluent of the Kiskiminetas, in the southeastern corner of Armstrong county, from which supplies were received in arks at a point on the Allegheny near to the furnace. Some ore was also brought by difficult wagon transportation from the vicinity of Fort Ligonier and Laughlinstown, in Westmoreland county. But the expense entailed in bringing ore from localities so difficult of access in those days was too great to justify the continued working of the furnace. After its abandonment Anshutz accepted the management of John Probst's Westmoreland furnace, near Laughlinstown, and continued there about one year, whence he removed to Huntingdon county, where, in connection with Judge John Gloninger and Mordecai Massey, he built Huntingdon furnace in 1796. Massey owned the land, Gloninger furnished the money, and Anshutz supplied the necessary experience and skill, with an understanding, we believe, that he was subsequently to become a partner. In 1808 he became the owner of one-fourth interest in the furnace. At this furnace most of the remaining years of his

long and useful and prosperous life were spent. When about eighty years of age he retired from active business, and with his family removed to the scene of his early trials, Pittsburgh, about 1833. Here he died, February 28, 1837, at the age of eighty-three, in a house that had been built under his own directions, on the bank of the Monongahela river. He was buried in the old German burying-ground in Pittsburgh, but his remains were some years afterwards removed to Allegheny cemetery. He left a large number of descendants.

Anshutz's furnace at Pittsburgh was built at a point about four miles east of the site of Fort Pitt, and midway between the Allegheny and Monongahela rivers, on a stream known then and now as Two-Mile run, on the bank of which Colonel Jonas Roup had previously at an early period, after emigrating from the Cumberland valley, erected a grist and saw mill. In 1794 the fire of the furnace lighted up the camp of the participants in the whisky insurrection. There was no forge connected with the furnace. The enterprise seems to have been largely devoted to the casting of stoves and grates, which, with the coal from the surrounding hills, gave comfort and cheer to the people of the neighborhood. The ruins of the furnace disappeared about 1850 from the spot that had long known them, within the eastern line of the Roup farm, and now within the enclosure of William O'Hara Scully, at Shady Side. When the track of the Pennsylvania Railroad was graded at Shady Side, in 1851, a portion of the furnace building was demolished and a part of its foundation was removed. Subsequently, in digging the cellar of Alexander Pitcairn's house, a portion of the cinder bank was exposed.

Second Stage in the Development of the Iron Industry at Pittsburgh.—The first iron foundry at Pittsburgh was established in 1803 by Joseph McClurg, on the site of the present post-office and the city hall. In 1812 it was converted by him into a cannon foundry. In 1807 there were three nail factories in existence in Pittsburgh—Porter's, Sturgeon's, and Stewart's, according to Cramer's *Almanac*, one of which made 100 tons of cut and wrought nails annually. In 1810 about 200 tons of cut and wrought nails were made at Pittsburgh. The first steamboat on the Ohio river, the *New Orleans*, was built at Pittsburgh in 1811. In 1813 there were two foundries in Pittsburgh, McClurg's and Anthony Beelen's; one steel furnace, owned by Tuper & McKowan; and

one rolling-mill, owned by Christopher Cowan. Cowan's rolling-mill was known as the Pittsburgh rolling-mill. The first "patent" nail machine introduced into Pittsburgh is said to have been used in this rolling-mill in 1814. The second rolling-mill in Pittsburgh was the Union, on the Monongahela river, built in 1819, and accidentally blown up and permanently dismantled in 1829, the machinery being taken to Covington, Kentucky. This mill had four puddling furnaces, the first in Pittsburgh. It was also the first mill in Pittsburgh to roll bar iron.

The following rolling-mills were in operation at Pittsburgh in 1826: Sligo mill was erected where it now stands by Robert T. Stewart and John Lyon in 1825, but was partly burned down that year. The Juniata ironworks were owned by Dr. Peter Shoenberger, and were erected in 1824. Grant's Hill works were erected in 1821 by William B. Hays and David Adams. They stood near where the court-house now stands. Water for the generation of steam had to be hauled from the Monongahela river. The Union rolling-mill, located east of Kensington, (Pipetown,) was the largest and most extensive of the kind in the Western country. It was built in 1819, and owned by Messrs. Baldwin, Robinson, McNickle & Beltzhoover. The Dowlais works, in Kensington, were built by George Lewis and Reuben Leonard in 1825. At Penn street and Cecil's alley, where the Fourth Ward schoolhouse now stands, stood the Pittsburgh rolling-mill, built in 1812, and in 1826 owned by R. Bowen. On Pine creek was the mill of M. B. Belknap, operated by both steam and water power. In 1817 this mill was a scythe and sickle factory. All of these mills did not make bar iron in 1826: some only manipulated rolled and hammered iron. In 1825 there were "eight air foundries and a cupola furnace" in Pittsburgh. Pig metal for the supply of these foundries and the rolling-mills was in part obtained from blast furnaces in the neighboring counties, but much of it was brought from the Juniata valley, which also supplied the mills with most of their blooms. The Juniata pig iron and blooms were hauled over the Allegheny mountains to Johnstown, usually on sleds in the winter season, and taken down the Conemaugh, Kiskiminetas, and Allegheny rivers to Pittsburgh with the spring and fall freshets.

In 1829 Pittsburgh had eight rolling-mills, using 6,000 tons of blooms, chiefly from the Juniata valley, and 1,500 tons of pig metal. In the same year there were nine foundries that consumed 3,500 tons of metal. In 1828 the iron rolled was 3,291 tons; in 1829 it

was 6,217 tons; and in 1830 it was 9,282 tons. It is stated that in 1830 one hundred steam-engines were built. In 1831 there were two steel furnaces, and cast iron began to be used for pillars, the caps and sills of windows, etc. In 1836 there were nine rolling-mills in operation, and eighteen foundries, engine-factories, and machine-shops. In 1856 there were in Pittsburgh and Allegheny county twenty-five rolling-mills and thirty-three foundries.

There were no blast furnaces in Pittsburgh and Allegheny county in 1858, but now there are twelve. Clinton furnace, built in 1859, by Graff, Bennett & Co., and blown in on the last Monday of October in that year, was the first furnace to be built in Allegheny county after the abandonment in 1794 of George Anshutz's furnace at Shady Side—a surprisingly long interregnum. Clinton furnace was followed in 1861 by the two Eliza furnaces of Laughlin & Co., and soon afterwards by others. The Lucy and Isabella furnaces have yielded larger weekly products of iron than any other furnaces in the country. The ores used at Pittsburgh are mainly obtained from the Lake Superior mines, but those of Missouri also furnish a large proportion.

There are thirty-two rolling-mills in Pittsburgh and Allegheny county in 1876, four of which make steel as well as iron. There are nine other establishments which make only steel. The Edgar Thomson Bessemer steel works, completed in 1875, occupy the site of Braddock's Field. The most surprising fact connected with the iron industry of Pittsburgh is that it all should have had its growth since the beginning of the present century.

Beginning of the Iron Industry in Other Western Counties.—Westmoreland furnace, near Laughlinstown, in Ligonier valley, Westmoreland county, on Four Mile run, a branch of Loyalhanna creek, was built about 1792 by John Probst, who also built a small forge about the same time. Neither the furnace nor the forge was long in operation, both probably ceasing to make iron about 1810. Colonel John McFarland, of Ligonier, informs us that he has used iron made at these works. On the 1st of August, 1795, George Anshutz, manager of Westmoreland furnace, advertised stoves and castings for sale. General Arthur St. Clair built Hermitage furnace, on Mill creek, two miles northeast of Ligonier, on the road to Johnstown, about 1802. It was managed for its owner by James Hamilton. The following advertisement appeared in *The Farmer's Register*, printed at Greensburg, Pa.,

November 21, 1806, by John M. Snowden. This advertisement had for its caption, "Hermitage Furnace in Blast," and was signed by Henry Weaver & Son, and dated at "Greensburg, September 12, 1806." It read as follows:

> The subscribers, being appointed agents by Gen. A. St. Clair, for the sale of his castings generally, and for the Borough of Greensburg exclusively, give notice that they will contract with any person or persons for the delivery of castings and stoves, for any number of tons, on good terms. Samples of the castings and stoves to be seen at their store, in Greensburg, any time after the 20th instant.

In 1810 Hermitage furnace passed out of the hands of General St. Clair, and stood idle for some time. In 1816 it was started again by O'Hara & Scully, under the management of John Henry Hopkins, afterwards Bishop of Vermont. In October, 1817, Mr. Hopkins left the furnace, himself a bankrupt, and it has never since been in operation. The stack is yet standing, and a large sycamore tree has grown out of the stone wall, about ten feet above the ground. General St. Clair died a poor man in 1818, aged eighty-four years, and is buried at Greensburg. Mount Hope furnace was built about 1810, in Donegal township, Westmoreland county, by Trevor & McClurg. Washington furnace, near Laughlinstown, in this county, was built about 1809, by Johnston, McClurg & Co. It was abandoned in 1826, and rebuilt in 1848 by John Bell & Co. It was in blast as late as 1854, and in 1859 was owned by L. C. Hall. Jonathan Maybury & Co. owned Fountain furnace, in Westmoreland county, before 1812, but where this furnace was located we have been unable to learn. The firm was dissolved August 19, 1812. Kingston forge, erected in 1811 on Loyalhanna creek, Westmoreland county, ten miles east of Greensburg, by A. Johnston & Co., went into operation early in 1812. Ross furnace, on Tub Mill creek, in Fairfield township, Westmoreland county, was built in 1815, by James Paull, Jr., Col. J. D. Mathiot, and Isaac Meason, Jr., and abandoned about 1850. It made pig iron, stoves, sugar-kettles, pots, ovens, skillets, etc. Another furnace in Fairfield township was built a short distance below Ross furnace, on Tub Mill creek, by John Beninger, about 1810. He also built a small forge on the same stream, where the borough of Bolivar now stands. Both the furnace and forge ceased to make iron soon after they were built, the forge running until about 1816. When short of pig iron it sometimes made bar

iron direct from the ore, which was obtained near by. In 1834 a manufactory of axes and sickles was established at Covodesville, on Tub Mill creek, above Bolivar, by Uri Updegraff. The business was continued for eight years by Mr. Updegraff. Baldwin furnace, on Laurel run, near Ross furnace, is said to have been built by James Stewart about 1810. It ran but a short time. It was named after Henry Baldwin, afterwards a Judge of the United States Supreme Court, but then a leading lawyer of Pittsburgh. He may have helped to build the furnace.

Gordon, in his *Gazetteer of the State of Pennsylvania*, states that in 1832 there were in operation in Westmoreland county one furnace, Ross, operated by Colonel Mathiot, and one forge, Kingston, on Loyalhanna creek, operated by Alexander Johnston. The latter gentleman, whose name appears above in connection with two other iron enterprises, was the father of Governor William F. Johnston. He was born in Ireland in July, 1772, and died July 15, 1872, one hundred years old. The early Westmoreland furnaces shipped pig iron by boats or arks on the Conemaugh and Allegheny rivers to Pittsburgh, much of which found its way down the Ohio river to Cincinnati and Louisville.

Other furnaces in Westmoreland county were, Mount Pleasant, a very early furnace; California, built by Col. J. D. Mathiot and S. Cummins about 1852, on Furnace run branch of the Loyalhanna creek about a mile above the mouth of the run; Oak Grove, built in 1854 by Colonel John Clifford, near Ligonier, and owned in 1857 by James Tanner, of Pittsburgh; Valley furnace, at Hillsview, nine miles south of New Florence, built by L. C. Hall & Co. in 1855; Laurel Hill, about three miles below Baldwin furnace, on Laurel run, after its junction with Powder Mill run, commenced in 1845 or 1846 by Hezekiah Reid and finished about 1849 by Judge J. T. Hale of Centre county, and subsequently owned by various parties; Conemaugh, on the stream of that name, about eight miles west of Johnstown, built in 1847 by John C. Magill, Hon. Henry D. Foster, and Hon. Thomas White, and subsequently operated by George Rhey; Lockport, built in 1844 by William D. and Thomas McKernan, brothers, at the town of that name, twenty miles west of Johnstown, subsequently owned by William McKinney, of Lockport, and finally falling into the hands of Dr. Peter Shoenberger; Ramsey, built in 1847, on the Kiskiminetas, about four miles west of Saltsburg, Indiana county, by Frederick Overman, for Dr. J. R. Speer, of Pittsburgh, its owner

All of the above furnaces have been abandoned. There is only one furnace in the county now in operation, Charlotte, built by Everson, Knap & Co., at Scottdale, in 1873, where the firm of Everson, Macrum & Co. built a rolling-mill in the same year.

Shade furnace was built in 1807 or 1808, and was the first iron establishment in Somerset county. It was erected on the banks of Shade creek, about forty rods below the junction of Clear Shade and Dark Shade creeks. David Rodger, an old resident at Shade furnace, informs us that it was built by Gerehart & Reynolds upon land leased from Thomas Vickroy. Being in debt, their furnace and lease were sold by the sheriff to Ogle & Kimmell, of Somerset, who were succeeded by Thomas Gaghegan, who gave way to one Dunlap, when the property reverted to Thomas Vickroy. In November, 1813, we learn that Vickroy advertised Shade furnace for sale, at a great bargain, the advertisement appearing in the Pittsburgh *Mercury*, published by John M. Snowden. A sale was effected in 1819 to Mark Richards, Anthony S. Earl, and Benjamin Johns, of New Jersey, constituting the firm of Richards, Earl & Co., who operated the furnace down to about 1830. In 1820 they built a forge, called Shade, three-fourths of a mile below the furnace, which was carried on by William Earl for four or five years, and afterwards by John Hammer and others. In 1849 it made 30 tons of bars. The furnace was continued, at intervals, by various proprietors to the close of 1858. Daniel Weyand, Esq., of Somerset, at his death, in September, 1877, was the last owner of the property.

About 1811 Joseph Vickroy and Conrad Piper built Mary Ann forge, on Stony creek, about five miles below Shade furnace, and a half mile below the mouth of Shade creek. The forge was named after Mr. Piper's wife, who was a daughter of Thomas Vickroy and sister of Joseph Vickroy. David Livingston was subsequently the owner of the forge, and operated it for several years. Richard Geary, the father of Governor John W. Geary, was the millwright who built the forge for the owners. We have heard that pig iron was sometimes packed on horseback to this forge from Bedford county, the horses taking salt from the Conemaugh salt-works and bar iron as a return load.

In the year 1809 or 1810 Peter Kimmell and Matthias Scott built a forge for the manufacture of bar iron on Laurel Hill creek, now in Jefferson township, in the western part of Somerset county. Mr. Kimmell shortly after withdrew, and the establishment was run by Mr. Scott. Subsequently it passed into the hands of

Henry Benford and Jacob Ankeny, and ceased operations about 1815. Supplies of metal were obtained from Bedford and Fayette counties. About the year 1810 Robert Philson erected a forge and furnace on Casselman's river, in Turkeyfoot township. The ore was mined in the immediate vicinity. The enterprise was a bad investment, operations ceasing in three or four years. The next furnace in the county was Jackson furnace, near the Pittsburgh turnpike, on Laurel hill, built by Irvin Horrel, Philip Murphy, and Charles Ogle about 1825. It was unsuccessful in their hands. About 1833 Joseph and William Graham again put it in blast, only to be overcome by speedy disaster. In 1832 Gordon stated that there were three furnaces and three forges then in existence in the county. Rockingham furnace, two miles above Shade furnace, on Shade creek, was built in 1844 by John Foust, and subsequently operated by Custer & Little; Somerset furnace, at Forwardstown, was built by Huber, Linton & Myers in 1846, and afterwards owned by G. Ross Forward; and Wellersburg furnace was built by the Union Coal and Iron Company, in 1856, under the management of G. Ross Forward. All the furnaces and forges in Somerset county have been abandoned.

The first iron enterprise in Cambria county was a forge at Johnstown, built by John Buckwalter, of Chester county, on Stony creek, in 1809, and subsequently removed to the Conemaugh river, also at Johnstown, where it was operated with more or less regularity down to about 1825, although it was standing many years later. Its last owner was Peter Levergood. It was used to hammer bars out of Juniata pig iron. John Buckwalter was a descendant of Francis Buckwalter, a Protestant refugee from Germany, who emigrated to the vicinity of Phœnixville, in Chester county, in 1720, where he purchased 650 acres of land for £195. In 1810 it is recorded that about 200 pounds of nails, valued at $30, were made at Johnstown by one establishment. These nails may have been wholly made by hand labor. About 1813 or 1814 an enterprise was established at Johnstown by which nails were cut with a machine worked by a treadle, but without heads, which were afterwards added with another machine. The enterprise was established by Robert Pierson, who died in 1818, and was buried in the Union graveyard. His shop stood on the north side of Vine street, near Franklin. Cambria county has been noted as an iron centre since its first furnace, Cambria, was built by George S. King, David Stewart, John K. Shryock, and William L. Shryock in

1841, on Laurel run. It was followed by Mill Creek, built by John Bell & Co. in 1845; Ben's Creek, built by George S. King & Co. in 1846; Eliza, five miles west of Ebensburg, on Blacklick creek, commenced by Ritter & Rodgers in 1846 and completed by Ritter & Irvin in 1847; Mount Vernon, at Johnstown, built by Peter Levergood & Co. in 1846, and subsequently owned by Lintons & Galbreath; and Ashland, six miles north of Gallitzin, built by Joseph A. Conrad and Hugh McNeal in 1847. All these furnaces have been abandoned. The division line between Cambria and Indiana counties passed through the stack of Eliza furnace. The Cambria ironworks, at Johnstown, the most extensive in the United States, were commenced in 1853 by a company of which Mr. King was the originator. They now embrace iron and steel rolling-mills at Johnstown, and several large furnaces at Johnstown and in Blair county. In 1832 Gordon referred to the prospect of making iron from native ore in Cambria county as follows:—"And there is iron, as it is said by some, *but denied by others.*" To the enterprise of George S. King is this county indebted for the development of the iron ore within its borders.

The first iron enterprise in Indiana county was Indiana forge, on Findley's run, near the Conemaugh, built about 1837 by Henry Noble, who also built a small furnace as early as 1840. Both the furnace and forge were running in the last-named year. Pig iron for the forge was at first obtained from Allegheny furnace, in Blair county. Becoming embarrassed, Mr. Noble was succeeded by William D. and Thomas McKernan about 1843. About 1846 the property passed into the hands of Elias Baker, who built a new furnace and forge. Other furnaces in Indiana county were, Blacklick, built by David Stewart in 1846; Buena Vista, built by McClelland & Co. in 1847; and Loop, built by Hampton & Smith in 1847. Blacklick and Buena Vista were located on Blacklick creek, and Loop on the Little Mahoning, three miles below Smicksburg. All the Indiana furnaces and its solitary forge have been abandoned.

Beginning of the Iron Industry in Northwestern Pennsylvania.—A blast furnace was built at Beaver Falls, on the west side of Beaver river, in Beaver county, in 1802, by Hoopes, Townsend & Co., and blown in in 1804. A forge was connected with it from the beginning, and was in operation in 1806, according to Cramer's *Pittsburgh Almanac.* Both the furnace and forge were in operation

in 1816. The whole enterprise was abandoned about 1826. The ore used was picked out of gravel banks in the neighborhood in very small lumps. It has been erroneously stated that this was the only furnace erected in Beaver county. There was another early furnace in this county, named Bassenheim, built by Detmar Basse Müller, the history of which is so interesting that we make room for the following letter we have received from Mr. Henry Muntz, an aged citizen of Zelienople, in Butler county.

Bassenheim furnace was built and put into operation in the year 1814 by Dettmar Basse, a German gentleman of education, much enterprise, and some means. He carried it on to 1818, when he sold out to Daniel Beltzhoover, Robinson & McNickle, who worked it five or six years more. About that time, viz., 1824, the charcoal and iron ore beginning to fail in the neighborhood, and their capital being pretty much sunk, they ceased operations and retired leaving the furnace a ruin, and now there is nothing to mark the place of its location except a large stack of stone overgrown with moss and bushes, and also a great pile of cinders, clinkers, and ashes, to show where the furnace had been. This furnace was not located in Butler county, but in the adjoining county of Beaver, between two and three miles from Zelienople and lower down the Connoquenessing creek and about a mile west of the Butler county line. Its owners, Dettmar Basse and also Daniel Beltzhoover, resided at Bassenheim farm on the Butler side of the county line, and much of its business was transacted at Zelienople. These circumstances will account for the popular belief that this furnace was located in Butler county. There was no forge connected with it, nor any other work except to convert iron ore into pig metal, stoves, kettles, pots, fire irons, etc. The ore was mostly dug out of the ground within a mile or two of the furnace in lumps weighing from one pound to fifty, generally of a blue color. At first the bellows was blown by water-power, but, after the high water of the creek had washed one of the abutments of the dam away and let the water out, the owners were obliged to apply a steam-engine at considerable expense, by which it was afterwards operated with much trouble and little profit. After the war of 1812 times were very hard and money exceedingly scarce. One other reason that this work did not succeed and pay better was the great expense of getting its metal and wares to a market. I remember well that in February, 1818, $12 per ton were paid for hauling the pig metal to Pittsburgh, thirty miles, over a bad road.

John Henry Hopkins, afterwards Bishop of Vermont, and already mentioned in connection with General St. Clair's furnace near Ligonier, was engaged as a clerk at Bassenheim furnace about 1815.

Still another furnace in Beaver county was Homewood, in the northwestern part of the county, on the Beaver Canal, near the mouth of the Connoquenessing creek, and two miles from Homewood station on the Pittsburgh, Fort Wayne and Chicago Railway.

It was built by James Wood, of Pittsburgh, to use coke or bituminous coal, and was put in blast in 1858. It was finally blown out in 1867 or 1868.

Prior to 1845 there were only a few furnaces in the Shenango valley, all charcoal, one of the oldest of which was Springfield furnace, half a mile from Leesburg, and seven miles southeast of Mercer, built in 1837 and active in 1849. Day, in 1843, says: "two furnaces were wrought formerly, but have since been abandoned," and in confirmation of this statement we may quote the geographer, Joseph Scott, who says that in 1806 "a forge and furnace are now nearly erected" at New Castle. The first furnace in Lawrence county of which we have satisfactory information was Martha, at New Castle, built in 1844 to use charcoal. In 1849 it was owned by Power & Sons, and was soon afterwards abandoned. Cossallo rolling-mill was built at New Castle in 1842, by the Cossallo Iron Company, and Orizaba, at the same place, in 1847, by Peebles & Co. In 1845, and soon afterwards, several furnaces were built in this valley to use its splint coal in the raw state, particular mention of which, owing to their modern origin, is not deemed necessary. In 1876 there were 32 such furnaces in the valley, besides several rolling-mills.

We are able to fix the date of the erection of the first furnace in the once important but now neglected ironmaking district composed of Armstrong, Butler, Clarion, Venango, and other northwestern counties. This event took place in the year 1818, when Bear Creek furnace, in Armstrong county, one mile from Lawrenceburg in Butler county, was commenced by Ruggles, Stackpole & Whiting, who then owned the Pittsburgh rolling-mill. In the following year, owing to the failure of this firm, it passed uncompleted into the hands of Baldwin, Robinson, McNickle & Beltzhoover, and was probably purchased by them to supply pig metal to their rolling-mill at Pittsburgh. The furnace went into operation in 1819. It was abandoned long before 1850, but was running in 1832, in which year Gordon says it was owned by Henry Baldwin, Esq., and was reputed to be the largest furnace in the United States, having made forty tons of iron a week. The building of this furnace was superintended by Thomas C. Lewis, the projector of Colonel Isaac Meason's rolling-mill on Redstone creek, in Fayette county. The furnace was built to use coke, with steam-power. Its first blast was with this fuel, but the blast was too weak, and the furnace chilled after two or three tons of iron had been

made. Charcoal was then substituted. This furnace had a tram road, with wooden rails, in 1818. It is due to the memory of th pioneer, Thomas C. Lewis, that we should state that it was agains his earnest advice that the blast used in blowing in Bear Creel furnace with coke was insufficient. He predicted the failure whicl occurred. The blast was cold, and was about five pounds to th square inch.

The number of ironworks erected in the State in the ten year ending with 1830 was forty-nine, of which thirty were forges and rolling-mills and nineteen were blast furnaces. Some of these furnaces were in Butler and adjoining counties. After the manufacture of iron at Pittsburgh was fairly started about 1825, a demand was created for more pig iron than the Juniata valley and Fayette county could supply. This led to the development of the iron-ore beds in Clarion, Butler, Armstrong, and Venango counties. Rock furnace, on Roaring run, a tributary of the Kiskiminetas, four miles east of Apollo, in Armstrong county, was built about 1825 by James W. Biddle, of Pittsburgh, and others. In 1832 Biddle is said by Gordon to have owned this furnace, which produced about fifteen tons of iron a week. It has been abandoned since 1855. Slippery Rock furnace, in Butler county, and Clarion furnace, in Clarion county, were built in 1828—the latter by Hon. Christian Myers, a native of Lancaster county. Allegheny furnace, at Kittanning, in Armstrong county, and Venango furnace, on Oil creek, in Venango county, were built in 1830. In 1832 the former was owned by A. McNickle, and made about fourteen tons of iron weekly. From 1830 to 1850, but particularly after the passage of the tariff of 1842, this section of the State produced large quantities of charcoal pig iron. We particularize a few of the furnaces built soon after 1830: Beaver, five miles south of Shippenville, Clarion county, in 1835; Madison, on Piney creek, same county, in 1836; Shippen, near Shippenville, same county, in 1832; Lucinda, eight miles north of Clarion, in 1833; Clay, on Horse creek, Venango county, in 1832; Van Buren, on the Allegheny river, two miles southeast of Franklin, same county, in 1832; Rockland, in the same county, in 1832; Slab, on East Sandy creek, same county, in 1834; Mill Creek, in the same county, in 1835. There was no forge in Armstrong county in 1832, but there were a few forges in Butler and Venango counties. A forge was built at Shippenville in 1833.

In 1850 there were 11 furnaces existing in Armstrong county, 6 in Butler, 28 in Clarion, and 18 in Venango—63 in all. In 1858

there were 18 in Armstrong, 6 in Butler, 27 in Clarion, and 24 in Venango—75 in all. Many of these furnaces had, however, been abandoned at the latter date. Nearly every one has since then been abandoned. The discovery that bituminous coal could be profitably used in the manufacture of pig iron, and the subsequent discovery of the rich ores of Lake Superior, were influences which tended greatly to destroy the business of making charcoal pig iron in the counties named, and in Fayette, Westmoreland, Somerset, Cambria, and Indiana counties, and correspondingly to develop the iron business in the Shenango valley and elsewhere. But the distance of many of these furnaces from market, the lack of cheap means of transportation, and the growing scarcity of charcoal timber also had much to do with the abandonment of Western and Northwestern Pennsylvania charcoal furnaces. It is not improbable that the manufacture of pig iron in the Allegheny valley and in Fayette county may yet be revived by the general substitution of Connellsville coke for charcoal, as iron ore is still abundant.

The Great Western ironworks at Brady's Bend were commenced in 1840, embracing a rolling-mill and four furnaces to use coke. They have not been in operation for several years.

The iron manufactured in the Allegheny valley was taken down the Allegheny river on keel-boats and arks, the business of transporting it, as may readily be conjectured, being quite extensive.

Erie charcoal furnace, at Erie, was built in 1842, and abandoned in 1849. It used bog ore. It was owned by Charles M. Reed. Liberty furnace, on the north side of French creek, in Crawford county, was built in 1842 by Lowry & Co., of Meadville, and abandoned in 1849.

At the Siberian rolling-mill of Rogers & Burchfield, at Leechburg, Armstrong county, natural gas, taken from a well 1,200 feet deep, was first used as a fuel in the puddling furnace. In the fall of 1874 it was announced that during the preceding six months the gas had furnished all the fuel required for puddling, heating, and making steam, not one bushel of coal having been used.

Iron Ore has been found in Elk, Potter, Bradford, Juniata, and Wayne counties, but it has not been developed. Ore has recently been mined at Austinville, in Columbia township, Bradford county. Should it ever become necessary, Pennsylvania can add greatly to her present production of iron ore, and of fuel to smelt it there never can be any scarcity.

First Use of Bituminous Coke in the Manufacture of American Pig Iron.—Pig iron manufactured from bituminous coke is claimed to have been first made as a regular product in the United States by F. H. Oliphant, at Fairchance furnace, near Uniontown, Fayette county, Pennsylvania, in 1836. Mr. Oliphant sent to the Franklin Institute of Philadelphia samples of the metal produced and of the various materials used at his furnace. He did not, however, long continue to make coke iron, and resumed the manufacture of iron with charcoal. William Firmstone was successful in 1835 in making good gray forge iron for about one month at the end of a blast at Mary Ann furnace, in Trough Creek valley, Tod township, Huntingdon county, Pennsylvania, from coke made from Broad Top coal. This iron was taken to a forge two miles distant and made into blooms. We have been unable to verify the statement in French's *Iron Trade of the United States* (1858) that "coke was employed a few years before the Revolution in the manufacture of pig and refined bar iron." Undoubtedly, however, various attempts were made to use it before the successful experiments of Mr. Firmstone and Mr. Oliphant were made. We have recorded an unsuccessful attempt to use coke at Bear Creek furnace in 1819.

The Legislature of Pennsylvania passed an act June 16, 1836, "to encourage the manufacture of iron with coke or mineral coal," which authorized the organization of companies for the manufacture, transportation, and sale of iron made with coke or coal. Between 1835 and 1839 attempts were made at Karthaus, in Clearfield county, at Farrandsville, in Clinton county, on the west branch of the Susquehanna river, and at Astonville furnace, near Frozen run, in Lycoming county, to use coke, but the experiment was unfortunate in each instance. At Karthaus several hundred tons in all of white iron were produced at irregular intervals in a furnace which was built in 1836 by Peter Ritner (a brother of Governor Ritner) and John Say, and it ran spasmodically upon coke with cold blast until 1838. In that year Henry C. Carey, Burd Patterson, John White, and others, constituting the Clearfield Coal and Iron Company, employed William Firmstone to take charge of the furnace. In 1839 he put in a hot blast and raised the stack nine feet, making it 45 feet high, with boshes 13 feet in diameter. The furnace was blown in in September, and made several hundred tons of good foundry iron by the close of the year, when the whole enterprise was abandoned, owing to the lack of proper transportation

facilities. At Farrandsville, as we are informed by General Daniel Tyler, 3,500 tons of iron were made, but at such great cost, owing to the impurity of the coal and the distance of the ore, that further efforts to make iron with coke were abandoned. The furnace was blown in, according to General Tyler, in the summer of 1837, and ran probably until 1839. It was fitted up with a hot-blast apparatus, made in Glasgow, and the best known at that time in Scotland. The furnace at Frozen run made some iron from coke, but how much is not stated. In September, 1839, it was using charcoal. Lonaconing furnace, in Alleghany county, Maryland, was built in 1837, by the George's Creek Company, to use coke, and in June, 1839, it was making about 70 tons per week of good foundry iron. In the Frostburg coal basin of Maryland, nine miles northwest of Cumberland, two large blast furnaces were built in 1840, by the Mount Savage Company, to use coke. This enterprise was also successful. But the use of coke did not come rapidly into favor, and many experiments with it were attended with loss.

In 1849 there were only four furnaces in Pennsylvania which were classed as coke furnaces—those of the Brady's Bend Iron Company, and they made no iron in that year. In 1853 the Cambria Iron Company built four coke furnaces at Johnstown, which were blown in successfully, and have been in almost constant operation to this day. In 1854, so slowly had the whole country progressed in the manufacture of pig iron from raw bituminous coal and coke, that the total production from these two kinds of fuel in that year was only 54,485 net tons, Pennsylvania making 29,941 tons; Ohio, 15,000 tons; and other States, 9,544 tons. In 1876 the make of bituminous coal and coke pig iron in the whole country exceeded that of anthracite, and was more than treble that of charcoal. In that year the production of pig iron was as follows: bituminous coal and coke, 990,009 net tons; anthracite, 794,578 tons; charcoal, 308,649 tons: total, 2,093,236 net tons.

First Use of Anthracite Coal in the Manufacture of Pig Iron.—Down to 1838 all the blast furnaces in the United States, with the exception of a few coke furnaces, used charcoal for fuel. In that year pig iron was successfully made in Pennsylvania from anthracite coal. We present below a complete account of the first steps that were taken to use the new fuel in blast furnaces.

In 1840 Jesse B. Quinby testified, in the suit of Farr & Kunzi against the Schuylkill Navigation Company, that he used anthra-

cite coal at Harford furnace, Maryland, mixed with one-half charcoal, in 1815. He believed himself to be the first person in the United States to use anthracite coal in smelting iron. In 1826 the Lehigh Coal and Navigation Company erected near Mauch Chunk a small furnace intended to use anthracite in smelting iron. The enterprise was not successful. In 1827 unsuccessful experiments in smelting iron with anthracite coal from Rhode Island were made at one of the small blast furnaces in Kingston, Plymouth county, Massachusetts. These experiments failed because the blast used was cold. About 1827 a similar failure in the use of anthracite took place at Vizille, in France. Doubtless other unsuccessful attempts than those here recorded were made to smelt iron ore with anthracite coal, but these were probably the earliest.

In 1828 James B. Neilson, of Scotland, obtained a patent for the use of hot air in the smelting of iron ore in blast furnaces, and in 1837 the smelting of iron ore with anthracite coal by means of the Neilson hot-blast was successfully accomplished by George Crane, at his ironworks at Ynyscedwin, in Wales. Mr. Crane began the use of anthracite with hot blast on the 7th of February, 1837, in a blast furnace, obtaining 36 tons a week. In May of that year Solomon W. Roberts of Philadelphia visited his works and witnessed the complete success of the experiment. Mr. Crane had taken out a patent on the 28th of September, 1836, for smelting iron ore with anthracite coal. Upon the recommendation of Mr. Roberts, after his return from Wales, the Lehigh Crane Iron Company was organized in 1838 to manufacture pig iron from the anthracite coal of the Lehigh valley. In that year Erskine Hazard went to Wales for the company, and there made himself acquainted with the process of making anthracite iron. He ordered to be made such machinery as was necessary, under the direction of George Crane, the inventor, and engaged David Thomas, who was familiar with the process, to take charge of the erection of the works and the manufacture of the iron. Mr. Thomas arrived in the summer of 1839, and to his faithful and intelligent management much of the success of the enterprise is due. The first furnace of this company was successfully blown in on the 4th of July, 1840. But it was not the first successful anthracite furnace in this country, as will presently appear.

On the 19th of December, 1833, a patent was granted to Dr. F. W. Geissenheimer, of New York, for smelting iron ore with anthracite coal, by the application of heated air. Dr. Geissenheimer made

experiments in smelting iron ore with anthracite at the Valley furnace, northeast of Pottsville, but they were not successful, although the results achieved were highly encouraging.

In 1836–7 John Pott experimented at Manheim furnace, at Cressona, in Schuylkill county, with anthracite coal as a fuel for smelting iron ore. The experiment was so far successful as to satisfy Mr. Pott that the scheme was practicable, but for some unexplained reason the furnace was not operated for some time after the experiment was made. It was then remodeled and enlarged to better adapt it to the use of anthracite coal, but before the furnace was quite ready to be blown in an ice freshet in the early spring of 1841 swept away furnace, forge, and all. This was the end of Manheim ironworks. Mr. Pott is certainly entitled to the honor of having been one of the first to satisfactorily experiment with anthracite coal in the blast furnace. Of the character of the blast used by him we are not advised.

In 1837 Jarvis Van Buren, acting for a company, built a furnace at South Easton, in Northampton county, for the purpose of experimenting with anthracite coal as a fuel. Early in 1838 he was successful in making twenty tons of pig iron, when further operations were stopped in consequence of the blast being too weak. We are not informed whether the blast was hot or cold.

Late in 1837 Messrs. Joseph Baughman, Julius Guiteau, and Henry High, of Reading, experimented in smelting iron ore with anthracite coal in the old furnace of the Lehigh Coal and Navigation Company at Mauch Chunk, using about eighty per cent. of anthracite. The results were so encouraging that they built a small water-power furnace near the Mauch Chunk weigh-lock, which was completed in July, 1838. Blast was applied to this furnace August 27, and discontinued September 10, the temperature being heated up to about 200° F. The fuel used was mainly anthracite, but not exclusively. A new heating apparatus was procured, consisting of 200 feet of cast-iron pipe, 1½ inches thick, placed in a brick chamber at the tunnel head, and heated by a flame therefrom. Blast was applied late in November, 1838, the fuel used being anthracite exclusively, and "the furnace worked remarkably well for five weeks," up to January 12, 1839, when it was blown out for want of ore. Some improvements were made, and on July 26, 1839, the furnace was again put in blast and so continued until November 2, 1839, Mr. F. C. Lowthrop, of Trenton, being one of the partners at this time. For "about three months"

no other fuel than anthracite was used, the temperature of the blast being 400° to 600° F. Open tuyeres were used. About 100 tons of iron were made.

The next furnace to use anthracite was the Pioneer, built in 1837 and 1838 at Pottsville, by William Lyman, of Boston, under the auspices of Burd Patterson, and blast was unsuccessfully applied July 10, 1839. Benjamin Perry, who had blown in the coke furnace at Farrandsville, then took charge of it, and blew it in October 19, 1839, with complete success. This furnace was blown by steam-power. The blast was heated in ovens at the base of the furnace, with anthracite, to a temperature of 600°, and supplied through three tuyeres at a pressure of 2 to 2½ lbs. per square inch. The product was about 28 tons a week of good foundry iron. The furnace continued in blast for some time. A premium of $5,000 was paid by Nicholas Biddle and others to Mr. Lyman, as the first person in the United States who had made anthracite pig iron continuously for one hundred days. Danville furnace, in Montour county, was built by Biddle, Chambers & Co., and was successfully blown in with anthracite in April, 1840, producing 35 tons of iron weekly with steam-power. Roaring Creek furnace, in Montour county, built in 1839 by Burd Patterson & Co., was next blown in with anthracite, May 18, 1840, and produced 40 tons of iron weekly with water-power. A charcoal furnace at Phœnixville, built in 1837 by Reeves, Buck & Co., was blown in with anthracite, June 17, 1840, by William Firmstone, and produced from 28 to 30 tons of pig iron weekly with water-power. The hot-blast stove, which was planned and erected by Julius Guiteau, of the Mauch Chunk furnace, was situated on one side of the tunnel head, and heated by the escaping flame of the furnace. This furnace continued in blast until 1841. Columbia furnace, at Danville, was built in 1839 by George Patterson, and blown in with anthracite by Mr. Perry on July 2d, 1840, and made from 30 to 32 tons of iron weekly, using steam-power. The next furnace to use anthracite, and the last one we shall mention, was built at Catasauqua, for the Lehigh Crane Iron Company, in 1839, by David Thomas. It was successfully blown in by him on the 4th of July, 1840, as we have stated, and produced 50 tons a week of good foundry iron, water-power being used. Mr. Thomas was born in Wales in 1794, and is still living in the full enjoyment of all his faculties.

Mr. Firmstone writes that, at three of the above-mentioned furnaces, the Mauch Chunk, Phœnixville, and Columbia, the hot-blast

ovens were heated by the flame escaping from the furnace; at the others the ovens and boilers were on the ground, and heated by independent fires. At that early day the plan, now so general, of conveying the escaping gas in air-tight conduits to the boilers and ovens was not adopted. It was introduced by C. E. Detmold, a German engineer, now of New York, two or three years later. This method, which has since been greatly improved in American practice, was patented in France by Thomas & Laurens, and in Germany by Faber du Faur. Mr. Detmold was the agent of the last-named gentleman.

It will be observed that, while Mr. Neilson invented the hot blast, Dr. Geissenheimer was the first to propose the use of anthracite coal by means of heated air for the manufacture of pig iron, and that Mr. Crane was the first to successfully apply the hot blast of Mr. Neilson to this purpose. Dr. Geissenheimer experimented as early as 1833 with ovens for heating air before its introduction into the blast furnace in which anthracite was used as a fuel, and his patent bears date in that year; but his invention was not successfully applied until after Mr. Crane had made iron at Ynyscedwin. Dr. Geissenheimer is entitled to the honor of having proposed what Mr. Crane was the first to accomplish. His patent, limited to the United States, was purchased by Mr. Crane, who, in November, 1838, patented some additions to it in this country. The patent was never enforced here, but Mr. Crane compelled the ironmasters of Great Britain to pay him tribute. Dr. Geissenheimer died at Lebanon, Pa., where he had long resided.

The discovery, in 1839 and 1840, that anthracite coal could be successfully used in the manufacture of pig iron gave a great impetus to the iron industry in Maryland, New Jersey, and New York, as well as in Pennsylvania. The rich magnetic ores of New Jersey were first smelted with anthracite coal by Edwin Post, Esq., at Stanhope, in 1840. On the 1st of January, 1876, there were 225 anthracite furnaces in the country; 161 in Pennsylvania.

It is claimed that anthracite coal for the generation of steam was first used in this country in 1825 under the boilers of the rolling-mill at Phœnixville. It is also claimed that, two years later, in 1827, the first use of anthracite coal in the puddling furnace in this country was at the same rolling-mill. Jonah and George Thompson were the proprietors at the time. The use of anthracite for puddling did not become general until about 1840. In 1839 Ralph Crooker puddled with anthracite at the Boston Iron Company's works. About 1836 Thomas and Peter Cooper, brothers, used an-

thracite in a heating furnace at their rolling-mill in Thirty-third street, near Third avenue, New York, and about 1840 they began to puddle with anthracite.

First Use of Raw Bituminous Coal in the Manufacture of Pig Iron.—The bituminous coal of Eastern Ohio and Western Pennsylvania was the first that was successfully used in this country in its raw state for the reduction of iron ore in the blast furnace. In 1843 Day writes that the coal in the vicinity of Sharon, without coking, "has been tried successfully for smelting iron in a common charcoal furnace." Doubtless only an experimental trial is here alluded to. The further history of the beginning of this branch of our iron industry is circumstantially and we believe correctly stated in the following extract from a pamphlet entitled *Youngstown, Past and Present*, printed in 1875.

In July, 1845, Himrod & Vincent, of Mercer county, Pa., blew in the Clay furnace, not many miles from the Ohio line, on the waters of the Shenango. About three months afterwards, in consequence of a short supply of charcoal, as stated by Mr. Davis, their founder, a portion of coke was used to charge the furnace. Their coal belongs to seam No. 1, the seam which is now used at Sharon and Youngstown, in its raw state, variously known as "free-burning splint," or "block coal," and which never makes solid coke. A difficulty soon occurred with the cokers, and, as Mr. Himrod states, he conceived the plan of trying his coal without coking. The furnace continued to work well, and to produce a fair quality of metal. At the same time Messrs. Wilkinson, Wilkes & Co. were building a furnace on the Mahoning, at Lowell, Mahoning county, Ohio, intending to use mineral coal from seam No. 1, on which they owned a mine near Lowell. The credit of making the first iron with raw bituminous or semi-bituminous coal, in the United States, belongs to one of these firms. An account of the blowing in of the Lowell furnace, on the 8th of August, 1846, may be seen in the *Trumbull Democrat*, of Warren, dated August 15, 1846, where it is stated that to "these gentlemen (Wilkinson, Wilkes & Co.) belongs the honor of being the first persons in the United States who have succeeded in putting a furnace in blast with raw bituminous coal." According to Mr. Wilkes, writing from Painesville, April 2, 1869, this furnace was run with coke several months, but at what time it does not state. It is admitted that Mr. David Himrod, late of Youngstown, produced the first metal with raw coal, about the close of the year 1845, and has continued to use it ever since. The friends of Wilkinson & Co. claim that it was an accident, and a necessity, while their works were built and intended for raw coal.

In 1850 there were only four furnaces in the Mahoning valley and only seven in Pennsylvania (in Mercer county) which used raw bituminous coal. In 1876 there were in the country 206 furnaces using either raw or coked bituminous coal when in blast.

First Use of Lake Superior Iron Ore in the Blast Furnace.—The honor of having first used the iron ore of Lake Superior in a blast furnace is clearly due to David and John P. Agnew, brothers, proprietors of the Sharpsville furnace, at Sharpsville, Mercer county, Pennsylvania. This occurred in 1853, the same year in which three or four tons of the ore were shipped to the World's Fair at New York. The ore used at Sharpsville was procured from the Jackson mine, the pioneer of all the Lake Superior iron mines, and was mined and shipped before the completion of the railroad to the mine or the building of the docks at Marquette. The following extract from a letter which we have received from Mr. David Agnew gives the leading facts of the important experiment:

I claim that D. & J. P. Agnew were the first to use Lake Superior iron ore in a blast furnace, (the Sharpsville,) and that the experiment was successful. The facts are as follows: A small amount of Lake Superior ore was brought from Lake Superior before the completion of the canal and locks at the outlet of the lake, at a heavy expense, merely for trial. The first small canal-boat load from Erie was by request brought to the Sharpsville furnace, and there used as stated. The second boat-load was intended to be left at Clay furnace but in mistake was brought on to Sharpsville, and the next day was reshipped back to Clay furnace. The Sharon Iron Company, owning and controlling this ore, (the Jackson mine,) had purchased the Clay furnace, and very naturally wished to try it in their own furnace. These two small boat-loads carried all the ore received from Lake Superior until the following year, (1854,) when our connection with the Sharpsville furnace had ceased. The quantity used by us was small, yet sufficient to establish our claim.

Mr. Frank Allen, who was the manager of Clay furnace in 1853, has published a statement which corroborates the above in all essential particulars, but also shows that the Clay furnace was the first in the country to make the manufacture of iron from Lake Superior ore a regular business and a commercial success. This result was not accomplished until 1856. Mr. Allen says:

On the last day of November, in 1853, Samuel Clark boated a load of said ore from the Sharpsville furnace to the Clay furnace landing. We put it through the furnace and sent the product to Sharon. The next season all the Lake Superior ore left over at the Sharpsville furnace was sent to us, and during the years 1854–5, and until August, 1856, we had used in all about 400 tons of Lake Superior ore—some of it alone, but most of it mixed with other ores, and up to that date the working of it was not a success.

In October, 1856, we gave the Clay furnace a general overhauling, put in a new lining and hearth, and made material changes in the construction of the

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same, put her in blast late in the fall, and in a few days were making a beautiful article of iron from Lake Superior ore alone, and this was then considered to be the first real and successful working of said ore in a blast furnace.

Beginning of the Manufacture of Cast Steel in the United States.—German or blister steel was made at an early day in several of the American colonies, and the steel made in Pennsylvania during the last century and the early years of the present century was of this description. Steel of this quality was used in the manufacture of plowshares, scythes, shovels, spades, cross-cut and mill saws, etc. In 1805 there were two steel furnaces in Pennsylvania, producing annually 150 tons of steel. One of these was in Philadelphia county. In 1810 there were produced in the country 917 tons of steel, of which Pennsylvania produced 531 tons in five furnaces—one each in Philadelphia city, and in Philadelphia, Lancaster, Dauphin, and Fayette counties. In 1813 there was a steel furnace at Pittsburgh, owned by Tuper & McKowan. In 1829 an Englishman named Broadmeadow and his son made blister steel at Pittsburgh, and about 1831 they melted cast steel of low grade in pots of their own manufacture. Their establishment was located at Bayardstown, near the old Fifth Ward market-house. Josiah Ankrim & Son, file-makers, at Pittsburgh, are said to have succeeded in making their own steel about 1830. In 1831 Messrs. Whitmore & Havens successfully produced blister steel at Pittsburgh. In this year there were in the country fourteen steel furnaces for the manufacture of low-grade steel—two in Pittsburgh, one in Baltimore, three in Philadelphia, three in New York, one in York, Pa., one in Troy, two in New Jersey, and one in Boston. Their united capacity was 1,600 tons of steel annually. No crucible cast steel was then made in the United States, although there had been various unsuccessful attempts to make it. In 1833 the firm of G. & J. H. Shoenberger commenced to manufacture blister steel at Pittsburgh, and in 1841 they attempted the manufacture of crucible cast steel, but only to add another to the list of failures. About 1840 the firm of Isaac Jones & William Coleman was formed at Pittsburgh to manufacture blister and spring steel, which business they successfully prosecuted until 1845, when they were succeeded by Jones & Quigg, who built the Pittsburgh steel works. In 1846 Coleman, Hailman & Co. commenced the manufacture of blister and plow steel at Pittsburgh. Both of these firms were successful in making

all but first quality cast steel. The first slab of cast plow steel ever rolled in America was rolled by William Woods, at the steel works of Jones & Quigg, in 1846, and shipped to John Deere, of Moline, Illinois. About 1846 the firm of Tingle & Sugden, file-makers, at Pittsburgh, made their own steel. In 1850 the manufacture of American steel, all of low-grade quality, cast and blister, was confined to a few establishments, nearly all of which were in Pennsylvania. In that year thirteen establishments in Pennsylvania made 6,078 tons of steel, of which only 44 tons were cast steel. Of the thirteen establishments, six were in Pittsburgh.

The following is a list of all the works in the State engaged in the conversion of steel in 1850, with their product: James Rowland & Co., Kensington, Philadelphia, 600 tons; J. Robbins, Kensington, 500 tons; Earp & Brink, Kensington, 100 tons; Robert S. Johnson, Kensington, 400 tons; W. & H. Rowland, Oxford, Philadelphia, 700 tons; R. & G. D. Coleman, Martic, Lancaster county, 400 tons; R. H. & W. Coleman, Castlefin, York county, 100 tons; Singer, Hartman & Co., Pittsburgh, Allegheny county, 700 tons; Coleman, Hailman & Co., Pittsburgh, 800 tons; Jones & Quigg, Pittsburgh, 1,200 tons; Spang & Co., Pittsburgh, 200 tons; G. & J. H. Shoenberger, Pittsburgh, 200 tons; S. McKelvy, Pittsburgh, 178 tons, these works having been in operation only six months: total, 13 works, with an annual product of 6,078 tons. Of this quantity only 44 tons were cast steel, as already stated.

In 1852 McKelvy & Blair, of Pittsburgh, made cast steel of good quality, but not of the best. In 1853 the firm of Singer, Nimick & Co., of Pittsburgh, which had been organized in 1848, and in 1855 Isaac Jones, then doing business in his own name, were successful in producing the higher grades of cast steel for saw, machinery, and agricultural purposes, but they did not make tool steel of the best quality as a regular product. That honor was reserved for a new firm, beginning business in 1859. In that year the firm of Hussey, Wells & Co. was successful in making crucible cast steel of best quality as a regular product at Pittsburgh, and three years later the firm of Park, Brother & Co., also of Pittsburgh, accomplished the same achievement. These were, we believe, the first firms in the country to meet with complete success in this difficult department of American manufacturing enterprise. Hussey, Wells & Co. were also the first in the country to fully demonstrate the fact that American iron is equal to the best Swedish iron in the manufacture of best cast steel.

The manufacture of crucible and other steel in this country has received an immense impetus since 1860. In that year there were thirteen steel-making establishments in the country, and in 1870 there were thirty, all devoted to the manufacture of steel other than Bessemer. In 1876, omitting Bessemer works, there were sixty steel works in the United States, of which thirty-nine made crucible cast steel, and the remainder made puddled steel, open-hearth steel, or steel from steel scrap. Of the thirty-nine which made crucible steel, seven also made German or blister steel. Of these thirty-nine works, nineteen were located in Pennsylvania, most of them in Pittsburgh and its vicinity.

Introduction of the Bessemer Process into the United States.—The origin of the pneumatic or Bessemer process for converting pig iron into steel, through which a complete revolution in the manufacture of iron has already been effected, is scarcely twenty years old, although experiments looking to this result were commenced about twenty-six years ago. The process has been briefly explained to consist in forcing into molten pig iron, contained in a suitable vessel called a converter, streams of air under a high pressure, and, by the combination thus effected between the oxygen of the air and the carbon and silicon in the iron, decarburizing and desiliconizing the metal to the extent necessary to produce the desired temper of steel; the product thus made being cast into ingots or other forms, and treated in like manner as is customary in working cast steel.

The first person to suggest and to experiment upon the blowing of air into and through molten crude iron in a crucible or vessel without the use of fuel to retain the metal in the molten condition is believed to have been William Kelly, an ironmaster of Eddyville, Kentucky, who began at his furnace (Suwaunee) a series of experiments based upon this theory as early as 1851, a theory or principle which he patented in 1857. Henry Bessemer, of England, whose name has been given to the pneumatic process, secured his first patents for the manufacture of steel in 1855, but he did not announce his discovery of the pneumatic process until February 12, 1856, when it was patented. Mr. Bessemer secured patents in this country in the same year, but Mr. Kelly's claim of priority of invention was subsequently allowed by the Patent Office. But neither Mr. Kelly nor Mr. Bessemer was successful in making steel by the method each had respectively adopted.

Mr. Bessemer's process having failed to produce any successful result in the manufacture of steel, Robert F. Mushet, then of the Forest steel works, and now of Cheltenham, England, took out, on the 22d of September, 1856, a patent for his process of adding to molten pneumatized iron a molten triple compound of iron, carbon, and manganese, of which compound spiegeleisen was at that time the cheapest and most convenient form. The addition of from one to five per cent. of this compound to Bessemerized cast iron at once overcame the obstacle which had been fatal to the success of Mr. Bessemer's invention. Pending the publication of Mr. Mushet's patent, early in 1857, and during the erection for him of a blowing apparatus and small converter, provided by the late Samuel Holden Blackwell, of Dudley, Mr. Mushet obtained from the Ebbw Vale Iron Company a supply of Bessemerized hematite cast iron. This he melted in ordinary steel melting-pots, adding to the forty-four pounds' charge of each pot, when melted, two pounds of melted spiegeleisen. From this mixture ingots of from 500 to 800 pounds were cast, and one of these ingots was rolled at the Ebbw Vale iron-works into a double-headed rail, which was sent to Derby railway station, on the Midland Railroad, to be laid down there at a place where iron rails had sometimes to be renewed within three months. This was early in 1857. Sixteen years afterwards, in June, 1873, the rail referred to was taken out. This was the first Bessemer steel rail ever laid down, and during its life-time about 1,250,000 trains and a like number of detached engines and tenders passed over it.

Having, early in 1857, obtained the already-mentioned blowing apparatus and converter, Mr. Mushet was enabled in that year to cast small ingots of tool steel by the direct Bessemer process, with the addition of spiegeleisen by his own process. The first charge of Bessemer steel ever made with the addition of spiegeleisen was tapped from the small converter at Mr. Mushet's Forest steel works by a young workman, William Phelps, an iron miner, who is now, if living, a citizen of the United States.

In 1858 Mr. Goran Goransson, a Swedish ironmaster, operating upon fine manganesic Swedish pig iron, was enabled to produce Bessemer steel of excellent quality without adding spiegeleisen. Since then the Bessemer process has made rapid progress. Except in a few instances, when pure manganesic pig iron can be obtained, Mr. Mushet's process still continues to be absolutely essential in the manufacture of Bessemer steel. But Mr. Mushet, from adverse causes, over which he had no control, never received in his own

country, nor in any European country, the reward which was fairly due to him. The Iron and Steel Institute of England, however, in 1876 awarded to him the Bessemer gold medal for that year, in recognition of the great value of his discovery.

While the Bessemer process was being perfected abroad, Mr. Kelly was experimenting with his invention in this country. These experiments were largely conducted in 1857–8–9 at the Cambria ironworks, at Johnstown. The first pneumatic converter in America was built at Johnstown for Mr. Kelly, but no true steel was converted in it, although refined iron was successfully produced.

In May, 1863, E. B. Ward, of Detroit, Hon. Daniel J. Morrell, of Johnstown, William M. Lyon and James Park, Jr., of Pittsburgh, and Z. S. Durfee, of New Bedford, Massachusetts, having obtained control of the patents of William Kelly, organized the Kelly Process Company, under an agreement which gave the inventor and his representatives an interest which has proved to be valuable. The company resolved to establish experimental works, and also to acquire the patents in this country of Mr. Mushet for the use of spiegeleisen. Experimental works were accordingly established at Wyandotte, Michigan, and Mr. Durfee was sent to England to procure an assignment of Mr. Mushet's patents. The latter purpose was effected on the 24th of October, 1864, upon terms which admitted Mr. Mushet, Thomas D. Clare, and John N. Brown, of England, to membership in the Kelly Process Company. On the 5th of September, 1865, the company was further enlarged by the admission to membership of Charles P. Chouteau, James Harrison, and Felix Vallé, all of St. Louis.

The control in this country of Mr. Bessemer's original process, with all of the machinery necessary to its application, was obtained in 1864 by John F. Winslow, John A. Griswold, and Alexander L. Holley, all of Troy, New York, Mr. Holley visiting England in the interest of himself and associates. In the fall of that year the licensees of the Kelly patents succeeded in making Bessemer steel at their experimental works at Wyandotte, the works being under the general direction of William F. Durfee, who then made the first Bessemer steel in America. In February, 1865, Mr. Holley was successful at Troy in producing Bessemer steel at experimental works which he had constructed at that place in 1864 for the licensees of the Bessemer patents, Messrs. Winslow, Griswold and Holley. But as the licensees of the Kelly patents could not achieve success without Mr. Bessemer's machinery, and as the owners of

the right to use this machinery could not make steel without Mr. Mushet's improvement, an arrangement was effected by which all the patents were consolidated early in 1866. Under this arrangement, the titles to the Kelly, Bessemer, and Mushet patents were vested in Messrs. Winslow, Griswold, and Morrell, the first two being owners of two-thirds of the property, and Mr. Morrell holding the other third in trust for the members of the Kelly Process Company. This arrangement continued until the formation of the Pneumatic Steel Association, a joint-stock company organized under the laws of New York, in which the ownership of the consolidated patents was continued, Mr. Morrell being the president and Z. S. Durfee the secretary and treasurer. The consolidation, in 1866, of the various interests, which was effected mainly through the exertions of Mr. Morrell, was followed by a large reduction in the fees and royalties charged to licensees, and thenceforward the business of making Bessemer steel was rapidly extended in this country. The Pennsylvania steel works, at Harrisburg, were the first works in the country, after those at Troy, to make Bessemer steel as a commercial product, their first blow taking place in June, 1867. The fourth Bessemer steel works in the country were erected near Lewistown, Pa., and were known as the Freedom iron and steel works. They made their first blow May 1, 1868. They did not produce a good quality of steel, and in 1870 the company failed and the works were abandoned. To-day Pennsylvania possesses five out of eleven Bessemer steel establishments in the United States.

Important improvements upon Mr. Bessemer's machinery have been invented and patented by Mr. Holley and other American engineers, and the blooming mill for the reduction of steel ingots, erected first at the Cambria ironworks by George Fritz and patented by him, has proved to be of great value. The Bessemer process has also been improved by the professional chemists connected with the American works, who are gradually emancipating the domestic manufacture from all dependence upon foreign metals and ores. It is universally admitted that in the United States this industry has been brought to a higher state of perfection than it has attained in any other country.

The first Bessemer steel rails ever rolled in this country were rolled at the North Chicago rolling-mill, on the 24th day of May, 1865, from hammered blooms made at the Wyandotte rolling-mill from ingots of steel made at the experimental steel works at Wyandotte. The American Iron and Steel Association was in session at

Chicago at the time, and several of its members witnessed the rolling of these rails. One of the rails was taken to the hall occupied by the Association, and exhibited, and was subsequently placed on exhibition in the lobby of the Tremont House. The rolls upon which the blooms were rolled at the North Chicago rolling-mill were those which had been in use for rolling iron rails, and, though the reduction was quite too rapid for steel, the rails came out sound and well shaped. Several of these rails were laid in the track of one of the railroads running out of Chicago, and were still in use in 1875. The first steel rails rolled in the United States upon order, in the way of regular business, were rolled by the Cambria Iron Company, at Johnstown, Pa., in August, 1867, from ingots made at the works of the Pennsylvania Steel Company, at Harrisburg, Pa.; and by the Spuyten Duyvil Rolling-Mill Company, at Spuyten Duyvil, N. Y., early in September of that year, from ingots made at the Bessemer steel works, at Troy, N. Y., then owned by Messrs. Winslow & Griswold.

Introduction of the Siemens Gas Furnace and Siemens-Martin Process into the United States.—In 1856 Dr. C. W. Siemens, of London, England, the present president of the Iron and Steel Institute of that country, gave his attention, in conjunction with his brother, Frederick Siemens, both of whom were natives of Hanover, in Germany, to the construction of a gas furnace for the manufacture of iron, steel, glass, and other products which require a high and uniform heat. These gentlemen were successful in inventing the Siemens regenerative gas furnace, which has since been largely adopted in Europe and in this country. In 1864 Messrs. Emile and Pierre Martin, of the Sireuil Works, in France, with the assistance of Dr. Siemens, erected one of these furnaces to melt steel. In this furnace they produced cast steel of good quality and various tempers, and at the Paris Exposition of 1867 their product secured for them a gold medal. The Messrs. Martin subsequently obtained patents for various inventions of their own which were applicable to the manufacture of steel by the Siemens furnace.

Dr. Siemens had given his attention to the production of cast steel upon the hearth of a Siemens furnace since 1861, but had encountered great practical difficulties in establishing the process at the works of licensees of his furnace, namely, Charles Attwood, at Tow Law, in 1862, and the Barrow hematite works and the Fourchambault works in 1863 and 1864. Dr. Siemens claims, in a letter

that is now before us, that, both at Tow Law and Fourchambault, cast steel had been produced upon the open hearth of a Siemens furnace, which had been specially constructed by himself for that purpose, from pig metal, spiegeleisen, and scrap iron, previous to Messrs. Martins' connection with the process. The furnace at Tow Law was a small one, and several such furnaces are still working there in the manner originally designed by Dr. Siemens.

In 1865 Dr. Siemens commenced the erection at Birmingham, in England, of steel works of his own, in which the regenerative furnace should be used in producing steel. These works, which were fully equipped for service in 1867, have produced most satisfactory results. The Messrs. Martin gave their attention, in the language of Dr. Siemens, to the production of steel by the dissolution of wrought iron and steel scrap in a bath of pig metal, while his efforts were more especially directed to the production of steel by the use of pig metal and iron ores, either in the raw state or in a more or less reduced condition, which latter process is the one mostly employed in the United Kingdom to-day. The former, or Siemens-Martin process, is the one that is chiefly used in this country, and the credit of introducing it is due to Hon. Abram S. Hewitt, of New York, who was favorably impressed with it when visiting the Paris Exposition in 1867 as a commissioner of the United States. By his request, Mr. Frederick J. Slade, his business associate, went to Sireuil to study the process in order to put it into practice in this country.

On the 1st of December, 1862, Park, McCurdy & Co., of Pittsburgh, sent Mr. Lewis Powe, the manager of their copper mill, to England to study the manufacture of tin plates. While there he visited Birmingham, and saw a Siemens gas furnace and procured one of the Siemens pamphlets containing a full description of it. On his return home he called the attention of Mr. James Park, Jr., to the advantages of the furnace. Immediately after July 4, 1863, the erection of a Siemens gas furnace was commenced at the copper works. This furnace was erected for the purpose of melting and refining copper, and was completed on the 14th day of August, 1863. It worked well. It was constructed after the drawings contained in the Siemens pamphlet. In the fall of 1863 Mr. Powe revisited England, and while there had an interview with Dr. Siemens. Soon afterwards the firm of Park, Brother & Co. built a Siemens furnace to heat steel, but it was not long in use. In 1864 James B. Lyon & Co., of Pittsburgh, built a

Siemens gas furnace for making glass. The enterprise, however, although mechanically successful, met with an accident which suddenly brought it to an end. It is proper to state that the introduction into this country of the Siemens furnace by the above-named firms was accomplished in an irregular manner, without first obtaining a license from Dr. Siemens, who had patented his invention.

The first Siemens gas furnace which was regularly introduced into this country for any purpose was built by John A. Griswold & Co., at Troy, New York, and used as a heating furnace in their rolling-mill, the license having been granted on the 18th of September, 1867. The next gas furnace which was regularly introduced was used as a heating furnace by the Nashua Iron and Steel Company, of New Hampshire, the license for which was granted on the 26th of September, 1867. The next furnace which was regularly introduced was built by Anderson & Woods, of Pittsburgh, for melting steel in pots, the license for which was dated in November, 1867. About 1869 the Lenox plate-glass works in Massachusetts also built a Siemens gas furnace. All of these furnaces gave satisfaction.

The first open-hearth furnace introduced into this country for the manufacture of steel by the Siemens-Martin process was built in 1868 by Cooper, Hewitt & Co., proprietors of the works of the New Jersey Steel and Iron Company at Trenton, New Jersey. The building of this furnace was commenced by this company in the spring of 1868, and in December of the same year it was put in operation.

The first successful application in this country of the Siemens furnace to the puddling of iron was under the direction of Mr. William F. Durfee, at the rolling-mill of the American Silver Steel Company, at Bridgeport, Connecticut, in 1869. Prior to this an unsuccessful attempt was made to accomplish the same result at the Eagle rolling-mill of James Wood & Company, at Saw Mill run, near Pittsburgh.

On the 1st of May, 1877, there had been built in this country 187 Siemens gas furnaces for use in the manufacture of steel and of iron and steel products, 88 of which were in Pennsylvania. Of the whole number, 35 were used in the production of crucible steel, 30 of which were in Pennsylvania, and 21 were used in the production of open-hearth steel, of which 5 were in Pennsylvania. In the year 1876 there were produced in the United States

21,490 net tons of open-hearth steel, of which Pennsylvania made 7,547 tons.

Experimental works have been erected at Pittsburgh in 1877, by Messrs. Park, Brother & Co., in conjunction with Messrs. Miller, Metcalf & Parkin, for the manufacture of wrought iron by a direct process invented by Dr. Siemens, and successfully tested by him at his experimental works at Towcester, England. The process embodies the application of the Siemens gas furnace.

The Whitwell Hot Blast was first applied in this country to the Rising Fawn furnace, in Dade county, Georgia, June 18th, 1875. The first application of this hot-blast in Pennsylvania was made at the Dunbar furnace, in Fayette county, in February, 1877.

First Iron Rails Made in the United States.—It has been stated by an English writer that the first rails used upon the Stockton and Darlington Railroad, the first complete railroad in the world, which was opened in 1825, were of wrought iron, rolled fish-bellied, with half-lap joints and weighing 28 pounds per yard: a small portion of the line was laid with cast-iron fish-bellied rails.

The first iron rails of any kind that were made in this country were made of cast iron. Solomon W. Roberts gives us this information concerning them:—"The Lehigh Coal and Navigation Company made a short section of experimental railroad in the summer of 1826, at its foundry at the upper end of the town of Mauch Chunk, and a car was run upon it. The idea then was to make a road with rails and chairs of cast iron, like those in use at the coal mines in the North of England. After casting a good many rails, each about four feet long, the plan was given up on account of its being too expensive."

Many years elapsed after the first railroad was built in this country before iron rails were made in American rolling-mills. Among the proposals to furnish rails for the Columbia and Philadelphia Railroad, received in May, 1831, there were none for American iron, and the whole quantity was purchased in England. Previous to the passage of the tariff act of 1842, rails were admitted into this country virtually free of duty. On the passage of that act some American capitalists began to think about making our own rails.

A few flat rails had been rolled prior to 1842, but such rails were only bar iron. On the Mauch Chunk Railroad, built in 1827,

the wooden stringers were strapped with common merchant bar iron, the flat bars being about one inch and a half wide and three-eighths of an inch thick. The holes for the spikes were drilled by hand. The flat rails which were afterwards made differed from merchant bars of the same size only in this, that the rail in its last passage through the rolls became indented, or countersunk, at regular distances. The centre of the countersunk surface was afterwards punched through for admitting the spike. As late as 1837, when the Erie and Kalamazoo Railroad was in course of construction from Toledo to Adrian, it was proposed to put down wooden rails, of oak studding four inches square, and to draw the cars by horses. But wiser counsels prevailed, and by great exertions sufficient funds were obtained to enable the management to iron the road with flat rails five-eighths of an inch thick. Flat rails continued in use in this country, notwithstanding the introduction of heavier rails, down to about 1850. "It was not until 1850 that the longitudinal sill and the flat rail were entirely removed from the Utica and Schenectady Railroad, the most important link in the New York Central line."

In 1844 the manufacture of heavy iron rails in this country was commenced at the Mount Savage rolling-mill, in Alleghany county, Maryland, erected in 1843 especially for rolling these rails. The first rail rolled at the Mount Savage rolling-mill, and for which the Franklin Institute of Philadelphia struck a silver medal, was a U rail, known in Wales as the Evans patent, of Dowlais ironworks, Merthyr Tydvil. It was intended to be laid on a wooden longitudinal sill, and was fastened to it by an iron wedge, keying under the sill, thus doing away with outside fastenings. This rail weighed 42 lbs. to the yard, and about 500 tons of it were laid in 1844 on a part of the road then being built between Mount Savage and Cumberland, a distance of nine miles. It was understood at the time to be the first heavy railroad iron made in America.

The Montour rolling-mill, at Danville, Pa., was built in 1845 expressly to roll rails, and here were rolled in October of that year the first T rails made in the country. The first T rail rolls made in this country were made for the Montour Iron Company by the firm of Haywood & Snider, proprietors of the Colliery ironworks at Pottsville, the work being done at their branch establishment at Danville. The Boston ironworks were started in January, 1824, to manufacture cut nails, hoops, and tack plates, but they subsequently rolled rails, and on the 6th of May, 1846, they rolled the

first T rails in Massachusetts, Ralph Crooker being superintendent. In 1845 the rolling-mill of Cooper & Hewitt was built at Trenton, N. J., to roll heavy rails, and on the 19th of June, 1846, their first rail was rolled. About the 1st of September, 1846, the New England Iron Company, at Providence, Rhode Island, commenced to roll T rails. The first lot of these rails rolled by the company was delivered to the Providence and Worcester Railroad, September 11, 1846. T rails were rolled in November, 1846, at Phœnixville, Pa.; in the fall of the same year at the Great Western ironworks at Brady's Bend, Pa.; early in 1847 at the Bay State rolling-mill, in Massachusetts, then owned by the Massachusetts Iron Company; in January, 1848, at the Rough-and-Ready rolling-mill at Danville, Pa.; and in the same year at Safe Harbor, Pa. All the T rails made at the mills above mentioned were rolled with a base or flange similar to that of the present T rail. A few other mills rolled heavy rails before 1850, but at the beginning of that year, owing to low duties, only two out of fifteen rail-mills in the country were in operation. It has been claimed that heavy rails in this country were first made at Brady's Bend; but this is a mistake, as the dates above fully show. The mill at this place was built in 1841, as a merchant bar mill, and any rails that it may have made prior to the fall of 1846 were flat rails. The first shipment of T rails made by the company was in June, 1847, by keel-boat on the Allegheny river to Pittsburgh.

The first T rails imported into this country were made to be fitted into cast-iron chairs, resting upon square stone blocks, but in a few years wooden cross-ties were used instead of the blocks. On the Boston and Lowell Railroad, which was completed in 1835, stone cross-ties were at first laid, some of which were in use as late as 1852. A thin wedge or key of wrought iron was driven between the inside of the chair and the rail, to keep the latter firmly in its place, and the operation of "driving keys" had to be repeated almost every day, owing to the tendency of moving trains to loosen them. Rails of this pattern were used for many years upon the Allegheny Portage Railroad in Pennsylvania and many of the stone blocks can now be seen in its abandoned bed. A writer on railroads, in *Johnson's Cyclopœdia*, states that the first T rails introduced into this country were laid on the New Orleans and Pontchartrain Railroad in 1831. Assuming that the statement is correct, the pattern used was undoubtedly that which we have just

described. Rails made with the broad base now found in all T rails are said to have been first made in England about 1836, for the Camden and Amboy Railroad of New Jersey, and the innovation is also said to have been the result of a futile effort to roll a rail and chair in one piece. In a notice of Robert Livingston Stevens, in the *American Cyclopœdia*, it is stated that "in 1836 he introduced the T rail on the Camden and Amboy Railroad, of which he was president for many years." The reference here is doubtless to the present form of the T rail. It seems strange that this form of rail should not have become generally popular in this country until many years after 1836.

The first thirty-foot rail rolled in this country is claimed to have been rolled at the Cambria ironworks at Johnstown, Pa., in 1855. These rails were perfectly made, but there being no demand for them they were used in the company's tracks. It is claimed that the first thirty-foot rails rolled in the country on order were rolled at the Montour rolling-mill, in January, 1859, for the Sunbury and Erie Railroad Company.

It is worthy of notice that, in 1876, one rolling-mill in Pennsylvania, the Cambria ironworks, rolled the largest aggregate of rails ever rolled in one year by one mill in this country. Its production of rails in that year was 103,743 net tons, of which 47,643 tons were iron rails and 56,100 tons were steel rails. Beginning business in 1853, it has since that year manufactured one-tenth of the total product of American rails.

Iron Shipbuilding in the United States.—The business of iron shipbuilding in this country may properly be said to date from the year 1839, when an iron steamboat was built at Pittsburgh, being the first enterprise of the kind in the United States. The vessel was called the *Valley Forge*. For general navigation purposes it was completely successful. Other iron vessels were subsequently built at Pittsburgh which fully realized the hopes of their builders, among them an iron schooner for ocean service, and an iron steamer, the *Michigan*, for service on the lakes—both built by order of the government about 1842. In that year Captain John Ericsson, of New York, furnished designs for four freight propeller iron steamers which were built for the Delaware and Raritan Canal, each 96 feet long, 24 feet beam, and 7 feet deep. In 1843 there were also built after his designs the propeller iron steamer *Legaré*, for the revenue

service, 150 feet long, 26 feet beam, and 10 feet deep, and four propeller boats for the Erie Canal, each 80 feet long, 14 feet beam, and 6 feet deep. In the same year Captain Ericsson built two steam passenger boats of iron to run on the James River Canal, in Virginia, and about the same time other small iron vessels were built after his designs. In 1846 an iron passenger steamer, the *Iron Witch*, 220 feet long, 27 feet beam, and 13 feet deep, was built at New York, after a design furnished by Captain Ericsson, to run on the Hudson river to Albany. About 1844 R. B. Forbes, of Boston, built a powerful iron wrecking vessel of 1,200 tons burden. The building of iron vessels made but slow progress, however, until after 1860.

During the civil war monitors and other iron vessels were built by the government, and Pittsburgh furnished many of the armor-plates which were required for them. The contract for the construction of the first turreted iron-clad vessel in the world, Ericsson's *Monitor*, was made by the United States Navy Department on the 4th of October, 1861, with Captain Ericsson, and on the 9th of March following it met and vanquished the Confederate iron-clad *Merrimack*. The *Monitor* foundered on the 13th of December, 1862, in a storm off Cape Hatteras, the accident being caused by mismanagement of the turret.

The history of the construction of this historic vessel and of other monitors built during the war is worthy of preservation, although not embracing all the monitors, and we give it as follows in an extract from a letter we have received from Captain Ericsson. We sought in vain for this information in all the histories of the war.

The *Monitor* was built under contract between the Secretary of the Navy and John Ericsson, whose sureties were John F. Winslow and John A. Griswold of Troy, and C. S. Bushnell of New Haven. The *Monitor* in all its parts was designed by me—hull, turret, steam machinery, anchor-hoister, gun-carriages, etc., all were built from working drawings made by my own hands, furnishing the rare instance of such a structure in all its details emanating from a single person. In carrying out the contract I employed the Novelty ironworks to build the turret; the Delamater ironworks to build the motive-engines, propeller, boilers, turret-gear, anchor-hoister, gun-carriages, and all other machinery; while I employed Thomas F. Rowland, of Greenpoint, to build the hull, attach the side armor, and launch the vessel—a difficult undertaking, which he carried out with much skill. The turret-plating and armor-plating, composed of a series of plates one inch thick, were rolled by H. Abbott & Son, of Baltimore.

Six monitor iron-clads of the Passaic class, viz., the *Passaic*, *Montauk*,

Catskill, *Patapsco*, *Sangamon*, and *Lehigh*, were also built under contract between the Secretary of the Navy and myself, the sureties being the gentlemen already mentioned. Of these six vessels, three were built in New York and three on the Delaware. I also built, under direct contract with the Secretary of the Navy, the large monitor iron-clads, *Dictator* and *Puritan*, the hull of the latter being built by Thomas F. Rowland, at Greenpoint, while the hull of the *Dictator* was built in New York by the Delamater iron-works. This establishment also built the turrets and furnished the entire machinery for both vessels, likewise from working drawings prepared by me. Four other monitor iron-clads of the Passaic class were also built by other parties, viz., *Weehawken* and *Camanche*, built at Jersey City, and the *Nahant* and *Nantucket* at Boston. The working drawings were, however, furnished by myself. The entire armor-plating and nearly the whole of the hull-plating of the several monitor iron-clads built by me were rolled by H. Abbott & Son, of Baltimore. The heavy forgings employed in constructing the turrets and steam machinery of the foregoing iron-clads were furnished by the Bridgewater ironworks, of Massachusetts.

The following monitor iron-clads were also built after my plans: *Catawba* and *Oneota*, built at Niles Works, Cincinnati; *Tippecanoe*, built by Miles Greenwood, Cincinnati; *Mahopac* and *Tecumseh*, built by Secor & Co., Jersey City; *Manhattan*, by Perine, Secor & Co., Jersey City; *Canonicus*, by Harrison Loring, Boston, Mass.; *Manayunk*, by Snowden & Mason, Pittsburgh; *Saugus*, by Harlan & Hollingsworth, Wilmington, Del.

The *Umpqua*, another monitor, was built at Pittsburgh in 1863. Among the iron vessels additional to the monitors which were built during the war may be mentioned the *New Ironsides* and the *Dunderberg*, the armor-plates for which were rolled at Pittsburgh.

In 1868 five iron steamships were built for ocean service. Since that year over two hundred iron vessels have been built in this country, and of these Pennsylvania has furnished the largest tonnage. The total tonnage of all the vessels built up to the beginning of 1877 is officially stated to be 197,500, the whole number of vessels being 251. Of these, 61 were rated from 1,000 to 2,000 tons; 9 from 2,000 to 3,000 tons; 8 from 3,000 to 4,000 tons; and 2 over 5,000 tons; the remaining 171 were under 1,000 tons. One firm, that of John Roach & Son, at Chester, Pa., has built 33 iron steamers since 1872, having a total tonnage of 68,150. The same firm has in the same time paid $14,890,000 for materials and labor.

Some of the finest iron steamships the world has yet seen have been built on the Delaware. The only line of passenger steamships plying between this country and Europe which is wholly owned by Americans, and carries the American flag, is the American Steamship Company's line, composed of four magnificent iron vessels, the

Pennsylvania, Ohio, Indiana, and *Illinois,* built at Philadelphia of Pennsylvania iron by Cramp & Sons, and running regularly between that port and Liverpool. No finer passenger vessels plow the Atlantic. Their length is 355 feet, breadth of beam, 43 feet, and depth of hold, 33 feet. They can accommodate 76 first-class passengers and about 800 intermediate and steerage passengers. Their tonnage capacity is 3,100 tons each; capacity of coal-bunkers, 720 tons each. Most of the European visitors to the Centennial Exhibition came to Philadelphia and returned to their homes in the vessels of this line. They have made so favorable an impression on the English underwriters that they have been accorded a rate of insurance lower than that of any other steamers in the Transatlantic trade, except two of the Cunard ships, and these two pay the same rate as the American line. In 1874 John Roach & Son built at Chester, Pa., for the Pacific Mail Steamship Company, two iron steamships of immense size and superior equipment, which fully equal in all respects the best of British-built iron steamers. These were the *City of Peking* and the *City of Tokio*—twin vessels in every respect. Their registered tonnage is 5,000 tons each. Each ship will accommodate 150 cabin passengers and 1,800 steerage passengers, and each vessel's coal-bunkers will carry 1,500 tons. The total weight of iron used in constructing each steamship was 5,400,000 pounds, and the cost of each was over $1,000,000.

The cost of building iron steamships on the Delaware is now as low as vessels of equal excellence can be built on the Clyde. In addition to the firms above named, the Harlan & Hollingsworth Company, and Pusey, Jones & Co., of Wilmington, and others on the Delaware, have extensive iron shipyards, and have built many iron vessels for ocean service. Up to 1876, owing to the popularity of iron steamships, only one iron sailing ship had been built in the United States. The statement that iron vessels can be built as cheaply in this country as abroad has attracted wide attention, and an increase in the orders for their construction may be speedily expected to follow.

Exports of Pennsylvania Iron Before the Revolution.—The exportation of pig iron from the colonies to Great Britain began in the years 1728–9, according to the most reliable records. In these years the colonies exported to England 1,156 tons, of which Pennsylvania contributed 274 tons. From 1728–9 to 1755 the exports to England from the iron-producing colonies aggregated 57,404

tons, including shipments to Scotland. Of this total, Pennsylvania shipped 4,604 tons. The exportation of bar iron from America began in 1717, when 2 tons of bars were sent to England from the British West India Islands of Nevis and St. Christopher, but which had evidently been taken there from the colonies. In 1718, 3 tons and 7 cwt. of bars were shipped from Virginia and Maryland to England. In 1735 Pennsylvania exported 10 tons, 17 cwt., and 3 qrs. of bar iron. From 1735 to 1755 the total exports of bar iron from the colonies to England and Scotland were 1,430 tons, of which Pennsylvania's share was 416 tons. From 1761 to 1776 the colonies exported 54,453 tons of pig iron and 18,723 tons of bar iron to England, of which the quantity exported by Pennsylvania can not now be ascertained. The amount of iron exported from Philadelphia in the year ending April 5, 1766, was 882 tons of bar iron at £26 per ton, and 813 tons of pig iron at £7 10s. per ton. In the three years preceding the war, ending January 5, 1774, the total exports from Pennsylvania were respectively 2,358, 2,205, and 1,564 tons. The proportions of pig and bar iron are not stated.

The above figures represent only colonial shipments of iron to the mother country, and no other export figures are obtainable. But it is known that the colonies also exported iron to the British West Indies, in exchange for their products, some of which iron found its way to the mother country, as we have seen above. Some of the colonies also exported iron to sister colonies. All of the colonies were prohibited, by acts of Parliament, from exporting their products to any foreign country except Great Britain. In 1756 Acrelius, the Swedish historian, wrote as follows:

> Pennsylvania, in regard to its ironworks, is the most advanced of all the American colonies. When New Jersey is added to it, one can safely say that from the Delaware the greatest part of the iron in America is taken. Herewith, however, the provinces of Maryland, Virginia, and New York deserve to be mentioned. . . . Pennsylvania, New Jersey, and Maryland supply more iron than their inhabitants need. From Maryland some pig iron is carried to Philadelphia in exchange for West India goods, as Maryland has but little commerce with the Islands, and no other offset against Philadelphia. The export is made to London, the West India Islands, and other English colonies on the continent of America.

British Measures to Prevent the Manufacture of Iron and Steel in the United States.—In 1749 an act of the British Parliament was

passed which encouraged the importation of American pig and bar iron into Great Britain by repealing the duties thereon, the object being to aid in the development of the finished iron trade of the mother country by supplying it with cheap raw iron, and to stimulate the exportation of woolen and other British manufactures to the colonies in exchange for their iron. The act did not contemplate the encouragement of finished iron manufactures in the colonies, but just the reverse, for it provided as follows:

"That from and after the twenty-fourth day of June, 1750, no mill or other engine for slitting or rolling of iron, or any plating forge to work with a tilt-hammer, or any furnace for making steel, shall be erected, or, after such erection, continued in any of His Majesty's colonies in America; and if any person or persons shall erect, or cause to be erected, or, after such erection, continue, or cause to be continued, in any of the said colonies, any such mill, engine, forge, or furnace, every person or persons so offending shall, for every such mill, engine, forge, or furnace, forfeit the sum of two hundred pounds of lawful money of Great Britain." And further: "That every such mill, engine, forge, or furnace so erected or continued, contrary to the directions of this act, shall be deemed a *common nuisance*," to be abated by "every governor, lieutenant-governor, or commander-in-chief of any of His Majesty's colonies in America, where any such mill, engine, forge, or furnace shall be erected or continued."

This oppressive and tyrannical act *was enforced.* In Pennsylvania the Lieutenant-Governor, James Hamilton, Esq., issued a proclamation, dated August 16, 1750, commanding the owners of every rolling and slitting mill, plating forge, and steel furnace in the province to appear before him, on or before the following 21st day of September, with "sufficient proofs whether the said mills, engines, forges, and furnaces respectively were used on the said 24th day of June, or not;" also commanding the sheriffs of all the counties in the province to furnish lists, on or before the 21st of September, of all such establishments within their respective jurisdictions, and to certify "whether they or any of them were used on the said 24th day of June, or not, as they and each of them will answer the contrary at their peril." Responses to this proclamation were made and are preserved. We have been shown in the library of the Historical Society of Pennsylvania an original copy of the proclamation, which was printed by Benjamin Franklin. In 1756, six years after this proclamation was issued, Acrelius stated that the Vincent steel works were not then in operation, and he afterwards added: "No one is allowed to make nails. The trip-hammers

which were erected some years since were condemned on account of their interference with the importation from England."

The enactment of this law, which will forever remain a stain upon the good name of the British people, was only one of a series of oppressive measures which eventually led to independence. They all interfered with the development of the manufactures of this country, the act from which we have quoted exercising a depressing effect upon the iron industry of Pennsylvania and other colonies down to the Revolution.

When the war of the Revolution was over, and the political independence of the United States was secured, Great Britain still sought, by means of restrictive measures, already enacted or specially devised, to prevent the industrial development of this country, so that its people might continue to be dependent upon the mother country for many crude and manufactured articles which, with proper encouragement from their own government, they could themselves produce. These restrictive measures, it is true, applied to other countries as well as to the United States, but upon no other country did they operate with such oppressive influence as upon this country. Skilled mechanics were prohibited from emigrating from Great Britain to other countries, and the exportation of tools or utensils used in the silk, linen, cotton, or woolen manufacture was also prohibited—the penalties in both cases being severe. In 1785 the emigration from Great Britain of iron and steel artificers and workmen and the exportation of tools used in the manufacture of iron and steel were specifically prohibited, and in 1795 the prohibition of the exportation of tools and machinery used in the manufacture of iron and steel was reaffirmed with emphasis. In the same act the prohibition of the exportation of tools and machinery was extended to other manufactures. The first of these restrictions was not wholly repealed until 1825, and the exportation of machinery for manufacturing was not relieved of all restrictions until 1842. The alien efforts that have been made to control the legislation of this country in the interest of British manufacturers are well known and need not be recited. They have been more or less successful until this day, and but for the courage and patriotism of Pennsylvania ironmasters, who have steadily opposed them, they would have been completely so, and the manufacturing and all the other industries of the country would have failed of the magnificent achievements that astonished the world at the close of the first century of our national existence.

Statistics of the Production of Iron and Steel in Pennsylvania in 1805.—In 1806 Joseph Scott published *A Geographical Description of Pennsylvania*, in which an attempt was made to collect the statistics of the iron industry of the State in the preceding year. Palpable errors and omissions appear in this part of Mr. Scott's book, but his statements are nevertheless worthy of preservation because of their antiquity. We condense them as follows, correcting transparent errors.

There were in the State, in 1805, 31 furnaces, 72 forges, 12 tilt-hammers, 2 steel furnaces, 11 slitting-mills, besides the slitting and rolling machinery, then abandoned, connected with the water-works of Philadelphia. The furnaces manufacture annually upwards of 21,000 tons of pig and castings, consisting of stoves, kettles, pots, pans, ladles, etc. The forges manufacture 12,960 tons of bar iron, and the slitting-mills upwards of 2,750 tons annually. About 150 tons of steel are yearly manufactured. The distribution of the ironworks of the State by counties was in part as follows: *Philadelphia county* (1805)—1 small forge, 2 furnaces, 1 tilt-hammer, 1 steel works. *Chester county* (1800)—4 slitting-mills, 2 furnaces, 8 forges, 12 tilt-hammers. *Lancaster county* (1805)—3 furnaces and 8 forges in the north end of the county. The furnaces usually manufacture about 1,200 tons annually of pigs, and the forges an equal number of tons of bar iron. Two of the forges were in the neighborhood of Churchtown. *York county* (1805)—2 forges. *Cumberland county* (1805)—2 slitting-mills and 3 furnaces. *Berks county* (1805)—1 slitting-mill, 8 furnaces, 20 forges, and 9 tilt-hammers. *Fayette county* (1805)—In the mountains are found large quantities of iron ore, for the manufacturing of which several furnaces and forges have been erected. They manufacture pig, bar iron, hollow ware, etc. Four forges and 3 furnaces are near Connellsville, and 2 forges and 2 furnaces are on George's creek. *Franklin county* (1805)—furnaces and forges have been erected, which manufacture pig, bar iron, hollow ware, etc. *Montgomery county* (1805)—4 forges. *Dauphin county* (1805)—2 furnaces and 2 forges have been erected. *Luzerne county* (1805)—2 forges have been erected, using bog iron ore. *Allegheny county* (1805)—a furnace has been erected within a few miles of Pittsburgh. *Delaware county* (1805)—7 forges and 1 slitting-mill. *Greene county* (1805)—a furnace in the neighborhood of Waynesborough. *Centre county* (1805)—in the mountains are found abundance of iron ore, which is manufactured into pig, bar iron, and hollow ware. *Mercer county* (1805)—a forge and furnace are now nearly erected at New Castle.

Statistics of the Production of Iron and Steel in 1810.—In 1814 there was published *A Statement of the Arts and Manufactures of the United States of America*, as they existed in 1810, prepared by Tench Coxe, under the authority of Albert Gallatin, Secretary of the Treasury. From this document we glean the following infor-

mation concerning the condition of the iron industry of Pennsylvania and of the country at large in 1810. In the totals for the United States we believe the values to be correct, as they include returns from every State, but some of the quantities given are not strictly accurate, because some of the States did not report quantities, although at the same time they reported values. We believe, however, that the quantities are approximately correct.

Number of Blast Furnaces in U. S., / Number of Air Furnaces in U. S.,	153;	in Pennsylvania, / in Pennsylvania,	44 / 6
Tons of Cast Iron made in U. S.,	53,908;	in Pennsylvania,	26,878
Value of Cast Iron made in U. S.,	$2,981,277;	in Pennsylvania,	$1,301,343
Number of Bloomaries in U. S.....	135;	in Pennsylvania,	4
Tons of Iron made in U. S.....	2,564;	in Pennsylvania,	.....
Value of Iron made in U. S.....	$226,034;	in Pennsylvania,	$16,000
Number of Forges in U. S.....	330;	in Pennsylvania,	78
Tons Bar Iron, etc., made in U. S.,	24,541;	in Pennsylvania,	10,969
Value of Bar Iron, etc., made in U. S.	$2,874,063;	in Pennsylvania,	$1,156,405
Number of Trip Hammers in U. S.,	316;	in Pennsylvania,	50
Product of Trip Hammers in tons,	600;	in Pennsylvania.....	
Value of Product of Trip Hammers,	$327,898;	in Pennsylvania,	$73,496
Rolling and Slitting Mills in U. S.,	34;	in Pennsylvania,	18
Tons of Rolled Iron made in U. S., / Product in Tons of Slit Iron in U. S.,	9,280;	in Pennsylvania, / in Pennsylvania,	4,502 / 98
Value of Rolled and Slit Iron in U. S.,	$1,215,946;	in Pennsylvania,	$606,426
Number of Naileries in U. S.....	410;	in Pennsylvania,	175
Pounds of Nails made in U. S.....	15,727,914;	in Pennsylvania,	7,270,825
Value of Nails made in U. S.....	$2,478,139;	in Pennsylvania,	$760,862

The product of Steel Furnaces in Massachusetts, Rhode Island, New Jersey, Pennsylvania, Virginia, and South Carolina was 917 tons, valued at $144,736. Of the whole number of Steel Furnaces, Pennsylvania contained 5, of which Philadelphia City, and Philadelphia, Lancaster, Dauphin, and Fayette counties each contained one. The product of Pennsylvania was 531 tons, valued at $81,147.

The following-named counties in Pennsylvania produced the iron accredited in this table to this State: Philadelphia, Montgomery, Bucks, Northampton, Delaware, Chester, Lancaster, Dauphin, Berks, Luzerne, Northumberland, Lycoming, Erie, Armstrong, Centre, Mifflin, Cumberland, York, Adams, Franklin, Bedford, Huntingdon, Cambria, Fayette, Westmoreland, Washington, Beaver, Butler, Allegheny, Mercer, and Crawford: thirty-one counties in all.

Statistics of the Production of Iron and Steel after 1810, and down to 1870.—In 1820 the value of all the manufactures of pig

iron and castings in the United States was $2,230,275, of which Pennsylvania produced $563,810 worth. In the same year the country produced "manufactures of wrought iron" to the amount of $4,640,669, of which Pennsylvania's share was $1,156,266.

In 1830 the value of the pig iron and castings manufactured in the United States was $4,757,403, of which the share of Pennsylvania was $1,643,702. In the same year the country's production of "manufactures of wrought iron" amounted in value to $16,737,251, of which Pennsylvania produced $3,762,847 worth. Gordon in 1832 claimed about 60 furnaces and a production of 50,000 tons of cast iron and 40,000 tons of bar iron in Pennsylvania.

In 1840 there were in the United States 804 furnaces, which produced in that year 286,903 tons of "cast iron." Pennsylvania had 213 furnaces, and produced 98,395 tons of "cast iron." In the same year there were 795 bloomaries, forges, and rolling-mills in the country, of which Pennsylvania had 169. The number of tons of bar iron produced in that year was 197,233, of which Pennsylvania's share was 87,244.

In 1842 there were 213 blast furnaces in the State, 169 forges and rolling-mills, and 151,885 tons of pig iron were produced. The production of pig iron in the State in 1843 was 190,000 tons, and in 1844 it was 246,000 tons. In 1846 there were 317 blast furnaces in the State, producing 368,056 tons of pig iron, and in 1847 there were the same number, producing 389,350 tons of pig iron. In 1849 the pig iron product of the State fell to 253,000 tons. The following statistics for that year are compiled from the valuable report of Charles E. Smith, Esq., published in 1850.

BLAST FURNACES IN PENNSYLVANIA.	No.	Investment.	Present capacity. Tons.	Make 1847. Tons.	Make 1849. Tons.
Anthracite coal	57	$3,221,000	221,400	151,331	109,168
Bituminous coal	7	223,000	12,600	7,800	4,900
Coke	4	800,000	12,000	10,000	.....
Charcoal hot blast	85	3,478,500	130,705	94,519	58,302
" cold blast	145	5,170,376	173,654	125,155	80,665
Bloomaries	6	28,700	600	545	335
Totals	304	$12,921,576	550,959	389,350	253,370

FORGES AND ROLLING-MILLS IN PENNSYLVANIA.	No. works.	Investment.	No. forge fires.	No. puddling fur.	Capacity. Tons.	Actual make 1847. Tons.	Actual make 1849. Tons.
Charcoal forges	121	$2,026,300	402	.....	50,250	39,967	28,495
Rolling-mills	79	5,554,200	.....	436	174,400	163,760	108,358
Totals	200	$7,580,500	402	436	224,650	203,727	136,853

The six bloomaries mentioned in the table were all in Carbon, Monroe, and Northampton counties, and all used the rich magnetic ores of New Jersey. They had 12 fires, 7 hammers, and made 335 tons of bars in 1849. They have all been abandoned.

In 1850 there were produced in the United States 563,755 tons of pig iron by 377 "establishments," of which Pennsylvania produced 285,702 tons of pig iron in 180 "establishments." In the same year the country produced "wrought-iron manufactures" to the amount of $22,629,271 in 552 "establishments," of which Pennsylvania produced $9,224,256 worth in 162 "establishments." These meagre statistics of production of iron in 1850 are from the census for that year, and the word "establishment" must not be confounded with single furnaces, forges, or rolling-mills. One establishment might embrace several separate ironworks.

In 1860 the United States, in 97 establishments, produced 51,290 tons of blooms, worth $2,623,178; Pennsylvania, in 57 establishments, produced 24,700 tons of blooms, worth $1,467,450. In the same year the United States, in 286 establishments, produced 987,559 tons of pig iron, worth $20,870,120; Pennsylvania, in 125 establishments, produced 580,049 tons of pig iron, worth $11,262,974. In 256 establishments the United States produced 513,213 tons of rolled iron worth $31,888,705; Pennsylvania, in 87 establishments, produced 266,253 tons of rolled iron worth $15,122,842. In 13 establishments the United States produced 11,838 tons of steel, worth $1,778,240; Pennsylvania, in 9 establishments, produced 9,890 tons of steel, worth $1,338,200.

In 1870 the United States, in 82 establishments, produced 110,808 tons of blooms, worth $7,647,054; Pennsylvania, in 43 establishments, produced 68,238 tons of blooms, worth $4,881,431. In 386 establishments the United States produced 2,052,821 tons of pig iron, worth $69,640,498; Pennsylvania, in 136 establishments, produced 1,033,272 tons of pig iron, worth $32,636,410. In 310 establishments the United States produced 1,468,312 tons of rolled iron, worth $120,311,158; Pennsylvania, in 120 establishments, produced 713,331 tons of rolled iron, worth $56,811,975. In 2 establishments the United States produced 19,403 tons of Bessemer steel, worth $1,818,220; Pennsylvania, in 1 establishment, produced 13,500 tons of Bessemer steel, worth $1,405,000. In 28 establishments, not including Bessemer steel works, the United States produced 30,354 tons of steel, worth $7,791,766; Pennsylvania, in 17 establishments, produced 21,806 tons of steel, worth $5,560,238.

Statistics of the Production of Iron and Steel in 1876.—In 1876 the United States, in 39 bloomaries, produced 20,784 net tons of blooms and billets from the ore, and in 59 forges produced 23,844 net tons of blooms from pig and scrap iron: total, 98 forges and bloomaries, producing 44,628 net tons of blooms and billets of all kinds. Pennsylvania, in 39 forges, produced 13,401 net tons of blooms from pig and scrap iron, and none from the ore. In 714 blast furnaces the United States produced 990,009 net tons of bituminous coal and coke pig iron, 794,578 net tons of anthracite pig iron, and 308,649 net tons of charcoal pig iron: total production, 2,093,236 net tons of pig iron. It is proper to state, however, that in 1876, in consequence of the panic of 1873, only a part of the ironworks of the United States were in operation. Pennsylvania, in 279 blast furnaces, produced 1,009,613 net tons of pig iron. Of this total, 588,829 net tons were anthracite pig iron, of which the Lehigh valley produced 261,274 net tons; the Schuylkill valley, 144,969 net tons; the Upper Susquehanna district, 79,217 net tons; and the Lower Susquehanna district, 103,369 net tons: 397,685 net tons were bituminous coal and coke pig iron, of which the Shenango valley produced 138,495 net tons; Pittsburgh and Allegheny county, 128,555 net tons; and districts outside of Allegheny county and the Shenango valley, 130,635 net tons: 23,099 net tons were charcoal pig iron, made in various localities.

In the United States in 1876 there were 338 rolling-mills, containing 4,488 single puddling furnaces, counting each double furnace as two single ones. Of these, 98 were built to make rails—60 heavy and 38 light rails, and 64 included cut-nail factories. The total production of rolled iron was 1,921,730 net tons, classified as follows: bar, angle, bolt, rod, and hoop iron, 668,956 net tons; plate and sheet iron, 165,255 net tons; cut nails and spikes, 207,890 net tons, or 4,157,814 kegs of 100 pounds each; and rails, 879,629 net tons, of which 412,461 net tons were Bessemer steel rails, and 467,168 net tons were iron and all other kinds. In Pennsylvania in 1876 there were 137 rolling-mills, containing 2,153 single puddling furnaces, counting each double furnace as two single ones. Of these, 35 were built to make rails—20 heavy and 15 light rails, and 25 included cut-nail factories. The total production of rolled iron in the State was 824,260 net tons, classified as follows: bar, angle, bolt, rod, and hoop iron, 301,350 net tons; plate and sheet iron, 100,576 net tons; cut nails and spikes, 68,409 net tons, or 1,368,163 kegs of 100 pounds each; and rails, 353,925 net tons, of

which 203,750 net tons were Bessemer steel rails, and 150,175 net tons were iron and all other kinds. Few mills ran full time.

In the United States there were 11 Bessemer steel establishments, which produced 525,996 net tons of ingots and rolled 412,461 net tons of rails, consuming 539,474 net tons of pig iron, of which 45,980 net tons were spiegeleisen. In Pennsylvania there were 5 Bessemer steel establishments, which produced 258,452 net tons of ingots and rolled 203,750 net tons of rails, consuming 260,487 net tons of pig iron, of which 25,180 net tons were spiegeleisen.

In 60 establishments, only 47 of which were active, however, the United States produced 71,178 net tons of puddled, open-hearth, blister, and crucible steel, of which 39,382 net tons were crucible steel, 21,490 net tons were open-hearth steel, and 10,306 net tons were puddled and blister steel. Including 525,996 net tons of Bessemer steel ingots, the total production of steel of all kinds in the United States in 1876 was 597,174 net tons. In 24 establishments Pennsylvania produced 43,365 net tons of puddled, open-hearth, blister, and crucible steel, of which 28,217 net tons were crucible steel, 7,547 net tons were open-hearth steel, and 7,601 net tons were puddled and blister steel. Including 258,452 net tons of Bessemer steel ingots, the total production of steel of all kinds in Pennsylvania in 1876 was 301,817 net tons.

The average price per gross ton in Philadelphia in 1876 of No. 1 anthracite foundry pig iron was $22.25. The average price per gross ton in Philadelphia of American iron rails was $41.25. The average price per gross ton of American Bessemer steel rails at the works in Pennsylvania was $52. The average price per gross ton of American best refined rolled bar iron in Philadelphia was $49.28.

The following-named counties in Pennsylvania contained iron or steel-making establishments in 1876, which were either in operation in that year or were ready to be put into operation:—Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Carbon, Centre, Chester, Clarion, Clinton, Columbia, Cumberland, Dauphin, Delaware, Erie, Fayette, Franklin, Huntingdon, Lancaster, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, Mercer, Mifflin, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Tioga, Union, Westmoreland, and York: total, 42 counties. The counties containing no iron or steel making establishments in 1876 were as follows:—Butler, Cameron, Clearfield, Crawford, Elk, Forest, Fulton, Greene, Indiana, Jefferson,

Juniata, McKean, Monroe, Pike, Potter, Snyder, Somerset, Sullivan, Susquehanna, Venango, Warren, Washington, Wayne, and Wyoming: total, 24 counties.

Table of States and Territories containing Iron and Steel Works in 1876, with their Production, showing the Position of Pennsylvania.—In the following table is presented a statement showing the number of iron and steel works in 1876 in each of the United States and Territories which made iron or steel in that year, together with the quantity of iron and steel produced by each State or Territory. The position of Pennsylvania in the list is so prominent that further attention need not be called to it.

STATES.	Number of Iron and Steel Works in 1876.				Production of Iron and Steel in 1876, in net tons.			
	Forges and Bloomaries.	Blast Furnaces	Rolling-Mills.	Steel Works, including Bessemer	Blooms.	Pig Iron.	Rolled Iron of all kinds.	Steel, including Bessemer Ingots
Maine	0	1	2	0	0	3,002	10,814	0
New Hampshire	0	0	1	1	0	0	1,900	1,000
Vermont	2	2	1	0	0	550	2,188	0
Massachusetts	1	6	22	4	151	5,040	78,576	5,085
Rhode Island	0	0	2	1	0	0	7,394	0
Connecticut	0	10	7	4	0	10,160	10,114	1,098
New York	27	57	23	4	20,202	181,620	130,707	35,859
New Jersey	5	18	17	8	2,828	25,349	52,411	7,458
Pennsylvania	39	279	187	29	13,401	1,009,613	824,260	301,817
Delaware	0	0	8	0	0	0	17,598	0
Maryland	1	24	5	1	4,256	19,876	31,181	470
Virginia	7	33	5	0	1,800	13,046	17,306	0
North Carolina	9	8	0	0	493	400	0	0
Georgia	0	11	2	0	0	10,518	12,001	0
Alabama	0	13	1	0	0	24,732	1,000	0
Texas	0	1	0	0	0	426	0	0
West Virginia	1	12	8	0	0	41,165	49,636	0
Kentucky	0	23	10	2	0	34,686	30,874	0
Tennessee	3	24	5	1	100	24,585	23,274	5
Ohio	0	100	48	8	0	403,277	249,328	59,936
Indiana	0	9	10	0	0	14,547	55,262	0
Illinois	0	12	10	5	0	54,168	191,421	171,963
Michigan	0	34	3	0	0	95,177	5,325	0
Wisconsin	0	14	1	0	0	51,261	29,980	0
Minnesota	0	1	0	0	0	0	0	0
Missouri	3	19	6	1	1,397	68,223	39,693	12,483
Kansas	0	0	2	0	0	0	14,707	0
Oregon	0	1	0	0	0	1,750	0	0
California	0	0	1	0	0	0	15,465	0
Utah Territory	0	2	0	0	0	65	0	0
Wyoming Territory	0	0	1	0	0	0	12,320	0
Total	98	714	338	69	44,628	2,093,236	1,921,730	597,174

It is proper to state that the 338 rolling-mills above enumerated include 19 works which both roll iron and make cast steel, one establishment which makes open-hearth steel and Bessemer steel, one which makes open-hearth steel and Bessemer steel and rolls iron, and 8 which both roll iron and make Bessemer steel. All

these establishments which make steel and the Bessemer one which makes nothing but steel are included in the column of steel works. The total production of rolled iron, 1,921,730 net tons, includes 412,461 net tons of Bessemer steel rails. The ingots of which these rails were made are also included in the column giving the total product of all kinds of steel. We have made the best possible analysis of the nature and extent of the iron enterprises of the country.

Comparative Statement by Counties of Pennsylvania Ironworks in 1850 and 1876.—The following table shows the number of iron and steel works existing in Pennsylvania in 1850 and 1876, with the names of the counties in which they were situated:

COUNTIES.	Blast Furnaces		Forges and Bloomaries.		Rolling-Mills and Steel Works.		COUNTIES.	Blast Furnaces		Forges and Bloomaries.		Rolling-Mills and Steel Works.	
	1850	1876	1850	1876	1850	1876		1850	1876	1850	1876	1850	1876
Adams	1	1	0	0	0	0	Indiana	4	0	1	0	0	0
Allegheny	0	11	0	1	16	43	Lancaster	16	15	12	2	2	6
Armstrong	16	8	0	0	2	3	Lawrence	2	10	0	0	2	3
Beaver	0	0	0	0	0	1	Lebanon	6	10	3	3	0	2
Bedford	3	3	3	0	0	0	Lehigh	9	28	0	0	0	3
Berks	13	27	23	4	5	10	Luzerne	5	5	1	0	2	1
Blair	12	14	14	5	1	4	Lycoming	3	1	3	0	2	2
Bradford	0	0	0	0	0	1	Mercer	16	23	0	0	0	6
Bucks	2	1	0	0	0	1	Mifflin	5	3	2	1	0	2
Butler	6	0	0	0	0	0	Monroe	0	0	1	0	0	0
Cambria	6	6	0	0	0	1	Montgomery	6	15	2	0	4	9
Carbon	4	4	6	0	0	1	Montour	0	7	0	0	0	4
Centre	10	6	5	3	5	4	Northampton	4	18	1	0	1	3
Chester	5	4	6	6	14	9	Northumberland	3	2	1	0	0	3
Clarion	29	3	1	0	0	0	Perry	5	3	1	2	1	1
Clearfield	1	0	0	0	0	0	Philadelphia	0	1	3	0	8	14
Clinton	5	1	1	1	0	0	Schuylkill	5	9	6	1	1	6
Columbia	16	3	1	1	3	1	Somerset	3	0	1	0	0	0
Cumberland	7	3	4	2	1	1	Tioga	1	1	0	0	1	0
Dauphin	6	12	2	1	1	5	Union	3	2	1	0	0	0
Delaware	0	0	0	0	1	2	Venango	20	0	0	0	1	0
Erie	1	1	0	0	0	1	Westmoreland	6	1	0	0	0	1
Fayette	5	5	0	0	2	1	York	5	2	3	1	0	1
Franklin	3	4	3	1	1	0							
Huntingdon	15	6	11	4	2	0	Total	298	279	127	39	79	156

Conclusion.—Such is a brief sketch of the progress of ironmaking in Pennsylvania down to the close of the first century of our national existence in the year 1876. If we have seemed to give undue prominence to the iron enterprises of some sections of the State, and to give to others less prominence than they deserve, the explanation is that in the one case we have had ample information and in the other case all desirable information could not be obtained. All apparently unnecessary details have been discarded, and due diligence has been exercised in seeking for valuable facts that were hard to find. The statistics we have given are reliable.

The development of the iron industry of Pennsylvania has kept pace with the progress made in the settlement of the State. It commenced in the Schuylkill valley, forty miles from Philadelphia, and soon after extended to the northward and southward of the city, and to the westward into Lancaster county. As the Indians retired but slowly, many years elapsed after Philadelphia was founded before the interior of the State was settled even by pioneers, and it was not until after the Revolution—a hundred years from the time when Penn sailed up the Delaware—that iron was made as far westward as the Juniata valley. But settlements in the extreme western and southwestern parts of the State were made almost simultaneously with those in the Juniata valley, and we find that iron was made in Fayette and Westmoreland counties about the same time that it was made within its boundaries. In the Susquehanna and Allegheny valleys iron was made soon after the tide of immigration rolled over their borders. Pittsburgh early became noted for its iron enterprises, although iron ore was not found in its immediate vicinity. Wherever the adventurous Pennsylvanians went the iron business took root if there was the least encouragement to establish it. Their furnaces and forges, and afterwards their rolling-mills, were conducted with as much skill and with as satisfactory results as characterized like establishments in the Old World. They showed themselves to be enterprising and progressively scientific ironmakers, so that at the beginning of the second half of the last century the State was far in advance of any other in the extent and variety of its iron manufactures—a position which has been steadily strengthened until this day, and which for generations to come it must continue to hold. Not only this, but Pennsylvania enterprise and capital have aided largely in establishing the iron manufacture in other States and Territories. But for the part taken by Pennsylvanians toward the middle of the last century, the iron industry of New Jersey would not have had an early and a healthy growth. But for their example and substantial assistance, the iron industry of the West and South would not have prospered as it has. But for their courage in resisting the arrogant trade pretensions of Great Britain, our own government would have withheld the encouragement that was necessary to the development of the iron industry of the whole country.

There are many features of the iron history of Pennsylvania which are not only curious but startling. But for the thinning

of its dense forests to supply charcoal for its forges and furnaces, the agriculture of the State would have lagged behind, from lack of tillable land as well as from lack of purchasers of agricultural products. But for the building of forges and furnaces and rolling-mills, which followed closely upon the building of pioneer cabins, the turnpikes and canals and railroads of the State would not so soon have become a necessity, for it is a remarkable fact that the making of iron preceded all of them. The forgeman and the furnaceman of Pennsylvania have never been far in the rear of the pioneer with his rifle. But for the great progress made in the manufacture of iron with charcoal in Pennsylvania, the way would not have been opened for the magnificent development of the coal fields of the State. The changes that have taken place in the iron manufacture of the State within the memory of men who are yet young astonish us by their magnitude. Down to about 1840 all the iron in the State was made with charcoal: now far less iron is made with charcoal than with any other fuel. Down to about 1835, in addition to making pig iron, many of the furnaces in the State cast stoves, pots, kettles, andirons, sadirons, railroad chairs, and other articles as a regular business: now none of them do. Down to about 1830 very little iron in the State was rolled; nearly all was hammered at the forges: now no bar iron is made at the forges and but little of any other shape. The first iron made in the State was made in bloomaries: in 1810 but four were reported; in 1850 six were reported; and long before 1876 the last one had disappeared. The introduction of the Bessemer and Siemens-Martin processes into the State, and into the country, dates since the close of the civil war, and the cast-steel industry of the State and country scarcely had an existence when the war commenced. As late as 1850 the furnace that would make fifty tons of pig iron a week with any kind of fuel was doing good work: now there are many furnaces in the State that make that much iron in a day, while a few can make seventy-five tons a day as a regular product, and two—the Isabella and Lucy furnaces at Pittsburgh—have made over a hundred tons a day for a week at a time. The changes that we have noted and others that might be mentioned have not been the result of accident nor the creation of necessity, but have resulted from the enterprise and skill of Pennsylvanians—a people who were not born to wait, with halting steps and timid hearts, with no touch of inspiration and no whisper of destiny, for others to lead where they could follow.

COAL MINING IN PENNSYLVANIA.

First Mention of the Existence of Coal in the United States.—In the *Statistics of Coal*, by Richard Cowling Taylor, (1848), it is stated that the earliest historic mention of coal in this country is by the French Jesuit missionary, Father Hennepin, who saw traces of bituminous coal on the Illinois river in 1679. In his journal he marks the site of a "cole mine," above Fort Crevecœur, near the present town of Ottawa. In 1763, nearly a hundred years later, Colonel Croghan, a British officer, noticed on the south side of the Wabash river "a high bank in which are several fine coal mines," which is the earliest reference, says Taylor, to coal in that region. In the map of the Middle Colonies, published by Lewis Evans in 1755, we find mention of coal in Ohio, but no mention of it is made anywhere within the present limits of Pennsylvania. In Nicholas Scull's map of Pennsylvania, published in 1759, coal is not marked. In William Scull's map of Pennsylvania, published in 1770, coal is marked in Berks county and at Pittsburgh. In the map of Captain Hutchins, published at London in 1777, coal deposits are marked at various places in the basin of the Ohio river. A coal seam near Pittsburgh took fire in 1765, and is said to have burned for sixteen years.

Anthracite coal was discovered in Rhode Island and Massachusetts about 1760. It has since then been discovered in Virginia, Arkansas, Oregon, New Mexico, and Pennsylvania in the United States, and in the State of Sonora in Mexico. It is also claimed that it has been discovered in Kansas and in Nova Scotia. But in none of the States named has the mining of anthracite ever been successfully prosecuted, except in Pennsylvania. In 1840 Virginia produced 200 tons of anthracite, and down to 1873 the total amount mined is estimated not to have exceeded 10,000 tons. In 1860 anthracite coal in the United States was produced only in Pennsyl-

vania and Rhode Island, and in the latter State the yield was only 1,000 net tons. In 1870 Rhode Island produced 14,000 net tons of anthracite, and Pennsylvania all the remainder that was mined in this country. Virtually, the American supply of anthracite coal is produced by Pennsylvania alone. The anthracite deposits in the other sections of the continent, alluded to above, are small in extent, unfavorably situated, or inferior in quality.

In 1804 the first discovery of coal west of the Mississippi was made by the exploring expedition under the leadership of Lewis and Clarke, who traced brown coal or lignite from about twenty miles above the Mandan villages, on the Missouri, nearly to the base of the Rocky mountains, and also upon the Yellowstone and other streams. In one of the exploring expeditions led by Captain Z. M. Pike "fine seams of coal" were discovered "far up the Osage river" in 1806. The existence of coal in Alabama was first noticed in 1834 by Dr. Alexander Jones, of Mobile. In 1870 coal was mined in twenty States and Territories of the United States.

The First Coal Mines in the United States Opened in Virginia.—The Virginia coal mines were undoubtedly the first that were worked in America. Mines of bituminous coal were opened and worked on the James river, in Chesterfield county, a few miles from Richmond, probably about 1750. Virginia coal was extensively used during the Revolution. An air-furnace was built at Westham, on the James river, six miles above Richmond, which used coal in the manufacture of shot and shell for the Revolutionary army until the furnace was destroyed by Benedict Arnold in 1781. Virginia coal was exported to various cities on the Atlantic coast before the Revolution. On the 31st of August, 1776, Thomas Wharton, Jr., and Owen Biddle, of Philadelphia, were authorized to employ proper persons to bring coal from Virginia which had been contracted for by the Committee of Safety. In 1789 Virginia coal sold in Philadelphia at 1*s.* 6*d.* a bushel. In 1846 the price at the same city was 20 to 22 cents a bushel, which was two or three cents per bushel higher than Allegheny bituminous coal. It was the scarcity of Virginia coal in the Philadelphia market, especially during the war with Great Britain, from 1812 to 1815, which largely contributed in the early part of the present century to the development of the vast anthracite coal deposits of Pennsylvania. The exportation of Virginia coal amounted to 42,000 tons in 1822, and it reached its culmination in 1833, when 142,000 tons were shipped to neighboring States. In

1842 the shipments had fallen to 65,000 tons. Up to about that year it was the principal source of domestic supply of mineral fuel in this country, and down to about 1850 it contributed the principal supply to the gas-works of Philadelphia and other American cities, for which use it was well adapted. For about twenty years after 1833 the importation of bituminous coal from Great Britain and the British Provinces into Philadelphia, principally for the gas-works, steadily increased, owing to the growing scarcity of Virginia coal. About 1856 the gas coals of Western Pennsylvania began to be used in Philadelphia, to the practical exclusion of the foreign supply.

Discovery of Coal in Maryland—Statistics of Cumberland Coal.—Coal is improbably said to have been discovered six miles north-east of Baltimore, by Benjamin Henfrey, in 1801. The Western Maryland coal basin was soon afterwards opened, and in 1820 the first shipment of coal from Alleghany county, Maryland, seems to have been made, when a few thousand tons were sent down the Potomac in boats. In 1832 the annual shipment of Cumberland coal down the Potomac had increased to about 300,000 bushels, most of which was not sent below Harper's Ferry. The price of Cumberland coal at tidewater at Georgetown in 1838 was 20 cents a bushel. In 1842 the shipment of Cumberland coal to Baltimore, by the Baltimore and Ohio Railroad, commenced, with a total tonnage for the year of 1,708 tons. The total shipments of Cumberland coal by all routes to the seaboard amounted in 1873 to 2,674,101 gross tons, and in 1876 to 1,835,081 tons. The growth of this trade is shown in the following official table of shipments:

Year.	Tons.	Year.	Tons.	Year.	Tons.	Year.	Tons.
1842	1,708	1851	257,679	1860	788,909	1869	1,882,669
1843	10,082	1852	334,178	1861	269 674	1870	1,717,075
1844	14,800	1853	533,979	1862	317,634	1871	2,345,153
1845	24,653	1854	659,681	1863	748,345	1872	2,355,471
1846	29;795	1855	662,272	1864	657,996	1873	2,674,101
1847	52,940	1856	706,450	1865	903,495	1874	2,410,895
1848	79,571	1857	582,486	1866	1,079,331	1875	2,342,773
1849	142,449	1858	649,656	1867	1,193,822	1876	1,835,081
1850	196,848	1859	724,354	1868	1,330,443	Total,	30,516,538

Development of the Great Coal Seam at Pittsburgh by Thomas Penn.—William J. Buck, in a paper read before the Historical Society of Pennsylvania on the 4th day of January, 1875, quotes from the Penn manuscripts to show that the Penns were fully aware as

early as 1769 of the existence of coal at Pittsburgh. Thomas Penn, in a letter of instructions, dated London, January 31, 1769, to his nephew, Lieutenant-Governor John Penn, says: "We desire you will order 5,000 acres of land to be laid out about Pittsburgh, including the town, which may now be laid out, and I think from its situation will become considerable in time; and that the land may be laid out to Colonel Francis and his associates, and other gentlemen of whom I wrote, as contiguous as it may be, and in regular right-angled tracts, if possible." On the following 12th of May he writes to Mr. Tilghman respecting this survey, and says: "I would not engross all the coal-hills, but rather leave the greater part to others who may work them." The difficulties between the mother country and her colonies prevented these instructions from being obeyed.

In 1784, however, the Penns, who retained their proprietary interest in large tracts of Pennsylvania after the close of the Revolution, including the manor of Pittsburgh, surveyed into building lots the town of Pittsburgh, and in the same year the privilege of mining coal in the "great seam" opposite the town was sold at the rate of £30 for each mining lot, extending back to the centre of the hill. This event may be regarded as forming the beginning of the coal trade of Pittsburgh. The Pittsburgh seam of bituminous coal is probably the most extensively accessible seam in this country. H. D. Rogers says of it that it spreads uninterruptedly over the whole valley of the Monongahela, from the base of the Chestnut ridge to the western boundary of the State, and west of the Ohio river.

The Western Pennsylvania Coal Trade—Statistics of Shipments.—The supply of the towns and cities on the Ohio and Mississippi rivers with Pittsburgh coal became an established business at a very early day after the close of the Revolutionary war. Down to 1850 all the coal shipped westward from Pittsburgh was floated down the Ohio in large flat-bottomed boats with the spring and fall freshets, each boat holding about 15,000 bushels of coal. The boats were usually lashed in pairs, and were sold and broken up when their destination was reached. In 1850 steam tow-boats were introduced, by means of which coal barges were towed down the river, and brought back when empty. This method of transporting coal from Pittsburgh by water has almost entirely superseded the primitive method. One tow-boat now tows or pushes a dozen barges, each barge holding about 12,000 bushels of coal.

Some Pittsburgh coal and large quantities of Connellsville coke are also shipped westward by railroad. Nearly all the coal now shipped from Pittsburgh is taken from the collieries on the Monongahela river, which is improved by slackwater navigation a distance of 85 miles from Pittsburgh to New Geneva, the Monongahela Navigation Company making its first shipments of coal in 1844. Since that year the total shipments of coal and coke by this company have been as follows in bushels, each thousand bushels being regarded as the equivalent of thirty-eight gross tons, which makes the weight of a bushel 85.12 pounds.

Year.	Bushels.	Year.	Bushels.	Year.	Bushels.	Year.	Bushels.
1844	737,150	1853	15,716,367	1862	18,583,956	1871	48,621,300
1845	4,605,185	1854	17,331,946	1863	26,444,252	1872	57,280,500
1846	7,778,911	1855	22,234,009	1864	35,070,917	1873	53,276,995
1847	9,645,127	1856	8,584,095	1865	39,522,792	1874	65,881,700
1848	9,819,361	1857	28,973,596	1866	42,605,300	1875	63,707,500
1849	9,708,507	1858	25,696,669	1867	30,072,700	1876	68,481,000
1850	12,297,967	1859	23,286,671	1868	45,301,000	1877	79,480,918
1851	12,521,228	1860	37,947,732	1869	52,512,600	Total,	1,076,820,914
1852	14,630,841	1861	20,865,722	1870	57,596,400		

Large quantities of Western Pennsylvania coal have annually been shipped eastward by the Pennsylvania Canal and the Pennsylvania Railroad, and of late years Connellsville and Westmoreland coke is finding a market east of the Alleghenies. Below is an official statement of the number of net tons of bituminous coal and coke forwarded to market over the Pennsylvania Railroad in the years 1875 and 1876.

MINES.	1875.			1876.		
	Coal.	Coke.	Total.	Coal.	Coke.	Total.
East Broad Top	53,567	.....	53,567	65,999	.....	65,999
Huntingdon and Broad Top	137,684	.....	137,684	93,881	.....	93,881
Cumberland	177,081	.....	177,081	147,784	.....	147,784
West Maryland Junction	2,870	.....	2,870	574	.....	574
Snow Shoe	62,426	.....	62,426	51,329	.....	51,329
Tyrone and Clearfield	915,288	286	915,574	1,190,418	.....	1,190,418
Gallitzin & Mountain regi'n	224,143	74	224,217	210,315	.....	210,315
West Pennsylvania Railr'd.	223,184	52,780	275,964	203,354	57,798	261,152
Southwest " "	29,262	549,382	578,644	57,169	539,630	596,799
Westmoreland region	733,671	36,273	769,944	896,810	60,465	957,275
Pittsburgh "	430,572	120,282	550,854	309,846	162,132	471,978
Totals	2,989,748	759,077	3,748,825	3,227,479	820,025	4,047,504

Beginning of the Business of Manufacturing Connellsville Coke.—Small quantities of coke were made in the Connellsville region early in the present century, and in 1836 pig iron was made with

coke by F. H. Oliphant at Fairchance furnace, near Uniontown, in Fayette county. The beginning of the regular manufacture of Connellsville coke, celebrated for its excellence and cheapness as a fuel for blast furnaces and for other manufacturing purposes, and for locomotives, is said by Dr. Frank Cowan to date from the summer of 1841, when William Turner, Sr., P. McCormick, and James Campbell employed John Taylor to erect two ovens for making coke on his farm lying on the Youghiogheny river, a few miles below Connellsville. The ovens were built of the bee-hive pattern. After repeated failures a fair quality of coke was produced in the early part of the winter of 1841–2. By the spring of 1842 enough coke had been made to load a coal boat ninety feet long. This boat was run down the Youghiogheny, down the Monongahela, and down the Ohio to Cincinnati, where a purchaser was obtained for the coke after some difficulty. This purchaser was Mr. Greenwood, a wealthy foundryman, and the price paid was 6¼ cents a bushel, half cash and half old mill irons. Others embarked in the business of manufacturing coke in 1842, Mordecai Cochran and Richard Brookius among the number, both of whom were successful. In 1844 improved ovens were introduced by Col. A. M. Hill, whose energy and success gave great impetus to the coke business.

In 1855 there were only twenty-six coke ovens at work on the Monongahela river, and in all Western Pennsylvania there were probably not over a hundred; now their number may be counted by thousands, most of which are built upon improved models. To-day Connellsville coke is extensively used in many States and Territories, its use extending even to Utah and California. It is free from sulphur. One hundred pounds of Connellsville coal make sixty-two and a half pounds of coke. Good coke is also made largely in Westmoreland county and in other sections of the western part of the State, the quality of which, like that of Connellsville coke, is nowhere surpassed outside of Pennsylvania, not even by that of the celebrated Durham coke of England.

Beginning of the Bituminous Coal Trade of Clearfield County.—On the 1st of November, 1785, Samuel Boyd patented a tract of bituminous coal land near Oldtown, in Clearfield county, Pennsylvania, but no coal from this tract was sent east of the Alleghenies until 1804. In that year William Boyd shipped the first ark-load of Clearfield county coal down the Susquehanna to Columbia, in Lancaster county, a distance of 260 miles. The new fuel, we are

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told, "was a matter of great surprise" to the good people of that county. Other ark-loads followed the first venture, and all the towns along the Susquehanna were soon familiar with bituminous coal. In 1828 the first cargo of Pennsylvania bituminous coal reached Philadelphia from Karthaus, in Clearfield county. The coal was taken down the Susquehanna to Port Deposit, at the head of Chesapeake bay, and thence by vessel to Philadelphia. About the same time coal was sent to Baltimore from the same place. The distance from market was too great, however, and the means of transportation too imperfect to permit the building up of a large trade in bituminous coal between the Alleghenies and the seaboard, and the situation was not materially changed for many years after the completion in 1834 of the Pennsylvania system of internal improvements. The competition of domestic anthracite, and of foreign and domestic bituminous coal, the last from Virginia and Maryland, was too great to be easily overcome, and in the case of anthracite it has never yet been overcome, although the shipments of Western Pennsylvania coal and coke to the seaboard are steadily increasing.

Description of the Anthracite Coal Fields of Pennsylvania.—S. H. Daddow, in the *American Cyclopædia*, (1873), gives the total area of the anthracite coal fields of Pennsylvania as 472 square miles, divided into the Wyoming field, 198 miles; the Schuylkill, 146 miles; the Lehigh, 37 miles; and the Middle, 91 miles. We present a brief description of the development of each of these divisions, which has been carefully collated from the highest authorities.

The Wyoming Field.—Anthracite coal was discovered in the Wyoming valley as early as 1766, as appears from a statement by Mr. Buck. He says that James Tilghman, of Philadelphia, addressed a letter to the Proprietaries, Thomas and Richard Penn, at Spring Garden, London, on the 14th day of August, 1766, in which he stated that his brother-in-law, Colonel Francis, had gone "up the N. E. Branch as far as Wyoming, where he says there is a considerable body of good land and a very great fund of coal in the hills, which surround a very fine and extensive bottom there. This coal is thought to be very fine. With his compliments he sends you a piece of the coal. This bed of coal, situate as it is on the side of the river, may some time or other be a thing of great value." By way of postscript he adds: "The coal is in a small package of the

Governor's." In a reply from Thomas Penn, dated London, the following 7th of November, to Mr. Tilghman, he says, in acknowledgment: "I desire you will return my thanks to Colonel Francis for his good services in removing the intruders that were settled on the Indians' land, and for the piece of coal, which we shall have examined by some persons skillful in that article, and send their observations on it." It is further stated by Mr. Buck that the next mention of coal in this section is in a draft by Charles Stewart, from a survey made in 1768 of a large tract of land on the west side of the Susquehanna, opposite the present borough of Wilkesbarre, which has "stone coal" marked thereon. The traveler, Dr. Schopf, tells us that in 1783 he found specimens of coal in the Swatara creek, in Lebanon county, and learned of its existence up the west branch of the Susquehanna.

The Wyoming valley was partly settled by a colony of Connecticut people in 1762, representing "The Susquehanna Company." In the same year the Indians murdered about twenty of the colony, and the remainder of the settlers were driven away. Gradually the survivors and others associated with them returned to the valley, and in 1768–9 it is claimed that two of the settlers, being two brothers named Gore, from Connecticut, who were blacksmiths, were the first in this country to use anthracite coal. This they did in their forge fire.

In 1776, and throughout the Revolutionary war, anthracite coal was taken in arks from the Wyoming mines above Wilkesbarre down the Susquehanna to the United States armory at Carlisle. Dr. Schopf visited Carlisle in 1783, where he informs us that just outside the town were situated four rows of old and new buildings, in which during the war a number of workmen were engaged in the manufacture of muskets, swords, and wrought-iron cannon of great strength. Mr. Buck says of the first shipment, that "two Durham boats were sent from Harris's Ferry, now Harrisburg, up the Susquehanna to Wyoming for anthracite coal, and about twenty tons were purchased from Mr. Geer and brought down to that place, whence it was hauled to Carlisle in wagons, and which appears was done annually during the Revolutionary war. This coal, we learn, was obtained from a bed belonging to Judge Hollenback, one mile above Wilkesbarre, near the mouth of Mill creek." Mr. Daddow says that some of it also came from the old Smith mine in the vicinity of Plymouth. The shipment of Wyoming coal down the Susquehanna in arks continued until the completion of the North

Branch Canal in July, 1834. The first cargo sent down the Susquehanna constituted the first shipment of anthracite coal that was made in this country. The price of coal at Wilkebarre in 1790 was $3 a ton.

At Carbondale, in the northeastern section of the Wyoming coal field, coal was discovered in 1804 by a surveyor named Samuel Preston, and in 1814 William and Maurice Wurtz commenced to make arrangements for its development. In 1815 they succeeded, after many discouraging adventures, in sending one ark-load of coal to Philadelphia, through the Lackawaxen and Delaware rivers, but the experiment was not repeated until 1823, after which shipments to Philadelphia were successfully made.

In 1829 the Delaware and Hudson Canal, 124 miles long, from Carbondale to the Hudson river, including 16 miles of railroad, was completed at a cost of $7,000,000, expressly to carry to Eastern markets the anthracite coal of the Wyoming valley. The railroad extends from Carbondale to Honesdale, and the canal extends from Honesdale to the Hudson river. In the same year 7,000 tons of coal were sent to New York by this route.

The Schuylkill Field.—Within the limits of the Schuylkill coal field anthracite coal appears to have been known to the settlers as early as 1770. In Scull's map of Pennsylvania, published in that year, "coal" is marked about the head waters of Schuylkill creek, thence stretching westward to those of the Swatara, and to "the wilderness of St. Anthony." This "wilderness," we may mention, extended from Peters's mountain, in Dauphin county, westward to the Kittatinny or Blue mountains.

The act of March 15, 1784, for the improvement of the navigation of the Schuylkill, mentions "the coal mines at Basler's sawmill" in Schuylkill county. A Yankee hunter, named Nicholas Allen, is said to have discovered coal in 1790 at the foot of Broad mountain, in the same county. No attempt to mine the coal which Allen had discovered seems to have been made. Reading Howell, in his map of Pennsylvania, published in 1792, marks the existence of "coal" near the source of Panther creek, about five miles east of the present town of Tamaqua, and on the border of Carbon county. We read that in 1795 a blacksmith named Whetstone used anthracite coal in his "smithery," near Pottsville, while others attempted to use it and abandoned it in disgust. About 1800 William Morris took a wagon-load of coal from near Port Carbon to Philadelphia,

but nobody wanted it, and Mr. Morris made no further efforts to mine or sell coal. About 1806 coal was found at Valley Forge, on the Schuylkill river, and a blacksmith named David Berlin and others successfully used it. In 1812 Col. George Shoemaker, of Pottsville, loaded nine wagons with coal from his mines at Centreville, and hauled it to Philadelphia, where with great difficulty he sold two loads at the cost of transportation, and gave the other seven loads away. He was by many regarded as an impostor for attempting to sell stone to the public as coal. Of the two loads sold, one was purchased by White & Hazard, for use at their wire-works at the Falls of Schuylkill, and the other was purchased by Malin & Bishop, for use at the Delaware County rolling-mill. By the merest accident of closing the furnace doors, Mr. White obtained a hot fire from the coal, and from this occurrence, happening in 1812, we may date the first successful use of anthracite coal in the manufactures of this country. Up to that time bituminous coal from Virginia had been exclusively used for manufacturing purposes in Philadelphia, and largely for domestic purposes. The war with Great Britain had, however, made Virginia coal very scarce, and it was very desirable that a substitute should be found. The following story is told of the success achieved by White & Hazard in the use of anthracite coal in their wire-works: A whole night was spent in endeavoring to make it burn, when the hands, in despair, quit their work, but left the furnace door shut. Fortunately, one of them forgot his jacket, and on returning to the works half an hour afterwards he noticed that the door was red hot, and the interior of the furnace in a white glowing heat. Thenceforward no trouble was experienced in making the new fuel burn. In 1815 the improvement of the navigation of the Schuylkill river was commenced by the Schuylkill Navigation Company, but many years elapsed before coal was taken to Philadelphia by this channel. In 1822 there were shipped 1480 tons to Philadelphia, but boats did not pass from Pottsville to Philadelphia until 1825, when 6,500 tons were sent down the Schuylkill. Prior to that year the coal trade of the Lehigh region had been opened.

The Lehigh Field.—The first discovery of anthracite coal in the Lehigh region is said to have been made in the Mauch Chunk mountain, about nine miles west of Mauch Chunk, where the village of Summit Hill is now located, by a poor hunter, named Philip Ginter, in 1791. Pieces of the coal discovered by Ginter were

taken to Colonel Jacob Weiss, at Fort Allen, who opened a "quarry" in the coal mountain that year. The discovery of coal on the Lehigh was announced as follows in the *New York Magazine* for February, 1792, in a communication dated Philadelphia, January 31: "A coal mine has been discovered on the Lehigh, in the county of Northampton. The coal yet found is small, but there is every reason to believe that by searching deeper it will be found larger. The quality is good. If this natural advantage is improved, it will be a prodigious resource to the city and cheapen the article of fuel, which now, from the labor of transportation, bears a high price." In 1793 Colonel Weiss, John Nicholson, Michael Hillegas, Charles Cist, Robert Morris, (of Revolutionary fame), J. Anthony Morris, and others organized the Lehigh Coal-Mine Company, which obtained control of about six thousand acres of coal land, and several tons of coal were soon "dug up." But there was no market nearer than Philadelphia, and there existed no means of communication with that city. It was not until 1803 that the company succeeded in floating two arks to Philadelphia, through the Lehigh and Delaware rivers, laden with two hundred tons of coal. Five arks were started, but three of these were wrecked. The coal, however, could not be made to burn, probably because large lumps were used, and was thrown away as useless for any purpose except to "gravel footwalks." In 1806 William Turnbull, of Philadelphia, floated three hundred bushels of coal from this region to Philadelphia, in an ark he had constructed at Lausanne. The coal was sold to the Central Square Water-Works, but it proved to be unmanageable, and Mr. Turnbull's experiment was not repeated.

To encourage the use of their coal, the Lehigh Coal-Mine Company executed, on the 18th of December, 1807, a lease for twenty-one years to James Butland and James Rowland of two hundred acres of their land in Northampton county, with the privilege of digging iron ore and coal free for the manufacture of iron. The enterprise was unsuccessful, and the lease was abandoned about 1814. We regard it as absolutely certain that no iron was made, and we think no coal was mined. The following extract from the proposition of Butland & Rowland, dated November 30, 1807, is worthy of preservation: "The subscribers, having obtained by patent from the United States an exclusive right of using a natural carbon or peculiar kind of coal, such as is found in the neighborhood of

the Lehigh and Susquehanna rivers, and other parts of the United States, for the purpose of manufacturing pig, cast, and bar iron, propose commencing the operation in such a situation as may be deemed best adapted to the purpose."

In 1814 two ark-loads of Lehigh coal reached Philadelphia from the mines of the Lehigh Coal-Mine Company, then leased by the Hon. Charles Miner and Jacob Cist, a son of Charles Cist, and this time the coal was sold at $21 a ton and successfully used by the purchasers, Josiah White and Erskine Hazard, who were then manufacturing wire at the Falls of Schuylkill. After this venture Miner and Cist abandoned the mining and shipment of anthracite coal. They had lost money. In 1817 White and Hazard and George F. A. Hauto became interested in the improvement of the navigation of the Lehigh river, for the purpose of aiding in the development of the Lehigh coal mines, and on the 20th of March, 1818, an act of the Legislature was passed authorizing the incorporation of the Lehigh Coal and Navigation Company. This company obtained a lease for twenty years of the Lehigh Coal-Mine Company's lands, then amounting to ten thousand acres, for one ear of corn a year, if demanded; with the proviso that, from and after three years, the latter company should send, on their own account, at least 40,000 bushels of coal, or about 1,500 tons, per annum to Philadelphia. The new company commenced work immediately. In 1820 it sent 365 tons of anthracite coal to market; in 1821, 1,073 tons; in 1822, 2,240 tons; in 1823, 5,823 tons; and in 1826 its trade increased to 31,280 tons, which seemed to be near the limit of the capacity of the works as then constructed. During the next year, 1827, the Mauch Chunk Railroad was finished, and the ascending navigation was put under contract, soon after which shipments steadily increased.

The Middle Field.—The Middle region, occupying a wild and broken section of country between the Wyoming and Schuylkill regions, and extending on the east to the Lehigh region, was the last of the four great anthracite coal fields of Pennsylvania to be developed. The Mahanoy and Shamokin basins compose its principal divisions. Coal pits or mines are marked in the neighborhood of Mahanoy creek, above Crab run, in Scull's map of Pennsylvania in 1770. But little mining was done in the region until 1834, owing mainly to its inaccessibility. In that year 500 tons were mined and hauled in wagons to neighboring districts.

First Use of Anthracite Coal in Pennsylvania in Stoves and Grates.—It is claimed by Dr. T. C. James, of Philadelphia, in a paper read before the Historical Society of Pennsylvania, on the 19th of April, 1826, that he successfully used anthracite coal in 1804 and thenceforward. Unfortunately, Dr. James does not say whether he used the coal in a stove or a grate. In the introduction to the census of the United States for 1860 it is stated that Oliver Evans, of Philadelphia, patented in 1800 a "luminous" grated stove, with talc light, with special reference to the use of mineral coal; "but Dr. Thomas C. James was one of the first to use it habitually in his house, which he continued to do from 1804 to 1826." In the Philadelphia *Sunday Dispatch* mention is made of the first cooking-stove to use anthracite coal, as follows:

In April, 1828, the *United States Gazette* described an invention which had recently been perfected by Williamson & Paynter, stove manufacturers, southwest corner of Ninth and Market streets, Philadelphia. It consisted of "a cast-iron box, fifteen to thirty inches in length, eight to ten inches wide, and six or seven inches deep. It has a grated bottom, and is calculated to burn anthracite coal as readily as charcoal. Upon one edge is placed a common tin kitchen, or roaster, in front of which, on the opposite edge, is a sheet-iron fixture of the same length, which reflects the heat upon the contents of the tin kitchen. Through the top of the reflector may be placed boilers for meats and vegetables. By means of false jambs, the size of the fire is reduced at will. By displacing the reflector and the tin-kitchen, the box or furnace may be used to heat water, roast coffee," etc. The contrivance was fixed on four iron wheels, and the cost of it, according to the *Gazette*, would not exceed nine dollars. This was undoubtedly the first improvement of the kind. Such an adaptation could not have been made until after anthracite coal came into common use. It was certainly a great addition to household economy, and was one of the most important improvements in stoves since Franklin invented the "Pennsylvania fireplace."

Down to 1808 the anthracite coal of the Wyoming valley was used only in smiths' forges, but in that year Judge Jesse Fell, of Wilkesbarre, was successful in using it in a grate, as clearly appears from a memorandum signed with his name and dated February 11, 1808. This may have been the first successful attempt that had been made to use the new fuel for domestic purposes in a grate, either in this country or in any other country. Anthracite coal was not used in Wales until 1813, nor in France until 1814. Its use in grates soon became general wherever it was mined or could be transported. "In the year 1788," says Judge Fell, "I used it in a nailery, and found it to be profitable in that business. The nails

made with it would neat the weight of the rods, and frequently a balance over."

Cost of Developing the Anthracite Coal Fields of Pennsylvania.—In Mr. Daddow's paper in the *American Cyclopædia* is a table of the canals and railroads which have been constructed for the transportation to market of the anthracite coal of Pennsylvania, and of the capital invested in its mining and transportation. From this table we learn that the length of the main track of the railroads built exclusively or mainly for the transportation of anthracite coal is 1,231¼ miles, of which 538¾ miles are double track: the length of the sidings and branches is 520½ miles. The length of the canals built for the same purpose is 673 miles. The cost of the railroads is placed at $128,000,000; of the canals at $47,000,000; of the coal lands at $75,000,000; and of the collieries at $43,700,000; total, $293,700,000. These figures are for 1873.

Miscellaneous Information About Coal Mining in Pennsylvania.—The well-known Blossburg semi-bituminous coal region of Pennsylvania, which annually produces about a million tons of coal, was not brought into public notice until after 1832, in which year it was geologically surveyed by R. C. Taylor. In 1840 its development began by the building of a railroad to reach Northern markets. In that year 4,235 tons were sent to market, followed by 25,966 tons in 1841. The Broad Top semi-bituminous coal section of the State was but very slightly developed until 1856, when the Huntingdon and Broad Top Railroad was completed and the first coal sent eastward to market.

Splint, or block, coal is found in the Shenango valley, and is largely used as it comes from the mine in the manufacture of pig iron. Mercer county produced half a million tons of this coal in 1871. Small deposits of cannel coal are found in the western part of the State. Previous to the discovery of petroleum in large quantities in Northwestern Pennsylvania, illuminating oil was distilled from cannel coal mined along the Allegheny river and elsewhere.

The use of anthracite coal for generating steam was attempted in Philadelphia very early in the present century, but it is stated that this use of anthracite was not successful until 1825, when the proprietors of the rolling-mill at Phœnixville used it under their boilers. It was used successfully about 1827 at the same mill in puddling iron. In 1837–8 successful experiments in smelting iron ore with

anthracite coal were made at Mauch Chunk, and in 1839 at Pottsville.

In the latter part of 1823 the Boston ironworks obtained a full cargo of Lehigh anthracite coal, for use in heating iron for the rolls in their mill, and for smith work. This was the first cargo of anthracite coal taken around Cape Cod. But, a short time previous to this transaction, and in the same year, Cyrus Alger of South Boston obtained a lot of about thirty tons of Lehigh coal, which he used in a cupola for melting iron for castings. In 1839 anthracite coal was used in puddling at the Boston ironworks by Ralph Crooker, the superintendent.

Outside of Pennsylvania the mining of anthracite coal is everywhere conducted on so small a scale that there is nowhere in the world to be found a single coal-breaker except in the northeastern part of this State. Of the sixty-six counties in Pennsylvania, only twenty-five contain no coal. There is practically no coal of any kind in the United States east or north of Pennsylvania. As no other country can successfully compete with this State in the production of anthracite, the exportation of the finest domestic fuel in the world should soon become a regular and extensive business.

Statistics of Coal Mining in the United States and in Pennsylvania. —The position of Pennsylvania among the coal-producing States and Territories of the United States is clearly shown in the statistics of coal production in the census year 1870, herewith presented, and in the accompanying statistics of production in 1874 and 1875, the latter prepared by Richard P. Rothwell. The official statistics for the census year are in net tons, but in compiling the statistics for 1874 and 1875 Mr. Rothwell has used the gross ton, and for the purpose of comparison he has presented in a parallel column the production of 1870 in gross tons.

It will be seen by reference to the table that the total production of coal in this country in 1870 was 29,342,580 gross tons, of which Pennsylvania produced 20,936,422 tons, or more than two-thirds of the whole. Of the total production, 13,985,960 gross tons, or almost one-half, were anthracite, and of this all was produced in Pennsylvania except 12,500 tons. By further reference to the table it will be observed that, in 1875, with which year the first century of the American Republic may be said to have closed, the total production of coal in the country was 47,513,235 gross tons, of which Pennsylvania produced 31,143,509 tons, or about two-thirds of the whole.

Of the total production by Pennsylvania, 20,643,509 gross tons were anthracite, and 10,500,000 tons were bituminous.

STATES.	Census Report June 1, 1870.	Year ending Dec. 31, 1874.	Year ending Dec. 31, 1875.	Per c'tage of the whole, 1875.
Alabama, bituminous	9,821	45,000	60,000	0.13
Arkansas, "	.....	5,000	9,000	0.02
California, post-carboniferous coal	.....	214,600	166,100	0.35
Colorado, " " "	4,018	150,000	150,000	0.32
Illinois, bituminous	2,343,003	3,000,000	3,500,000	7.37
Indiana, "	390,955	812,000	800,000	1.69
Iowa, "	235,256	1,500,000	1,500,000	3.16
Kansas, "	29,410	250,000	275,000	0.58
Kentucky, "	134,449	350,000	375,000	0.79
Maryland, "	1,624,343	2,410,895	2,342,773	4.94
Michigan, "	25,134	12,000	12,000	0.02
Missouri, "	555,295	714,000	750,000	1.58
Nebraska, "	1,272	1,300	1,300	.....
Nevada, post-carboniferous coal	.....	1,000	1,000	.....
Ohio, bituminous	2,256,504	3,810,344	4,346,533	9.15
Oregon, post-carboniferous coal	.....	43,200	28,800	0.06
Pennsylvania, anthracite* and bituminous†	20,936,422	32,667,386	31,143,509	65.54
Rhode Island, anthracite	12,500	17,000	11,000	0.02
Tennessee, bituminous	119,128	350,000	360,000	0.76
Utah, post-carboniferous coal	5,178	30,000	35,000	0.07
Virginia, " "	55,181	73,100	79,200	0.17
Washington, " "	12,932	27,100	38,900	0.16
West Virginia, bituminous	543,541	1,000,000	1,100,000	2.32
Wyoming, post-carboniferous coal	44,643	260,000	278,000	0.59
North Carolina, Georgia, and Indian Territory, bituminous	.....	60,000	100,000	0 21
Total anthracite	13,955,960	21,684,386	20,654,509	43.45
Total bituminous	15,281,668	25,330,539	26,031,726	54.78
Total post-carboniferous coal	124,952	799,000	827,000	1.74
Total of all kinds	29,342,580	47,813,925	47,513,235	100.00
* Anthracite	13,973,460	21,667,386	20,643,509	43.44
† Bituminous	6,962,962	11,000,000	10,500,000	22.10

We present below a table, which we have compiled from reliable sources, showing the production of mineral coal by all countries in late years, to which is added the share of Pennsylvania.

MINERAL COAL BY COUNTRIES.	Year.	Gross Tons.	Per cent. of total.
Great Britain	1875	131,867,105	47.62
United States	1875	47,513,235	17.16
Germany	1874	46,658,000	16.85
France	1876	17,047,761	6.15
Belgium	1876	15,011,330	5.42
Austria and Hungary	1875	12,852,048	4.64
Russia	1874	1,346,900	.49
Nova Scotia	1876	709,646	.26
New South Wales	1874	1,304,567	.47
Spain	1873	570,000	.21
India	1875	500,000	.18
Turkey in Europe and Asia	.....	150,000	.05
Japan	1874	390,000	.14
Chili, China, New Zealand, and other countries	.....	1,000,000	.36
Total	.....	276,920,592	100.00
United States, { Pennsylvania, 31,143,509 tons / Other States, 16,369,726 tons }	1875	47,513,235	17.16
Percentage of the world's production by Pennsylvania	.....	.....	11.05

The following statistics by districts of coal mined in Pennsylvania in 1873, a year of greater production than 1875 or 1876, and the year of greatest production since the beginning of coal mining in the State, are taken from Macfarlane's *Coal Regions of America.*

ANTHRACITE.—GROSS TONS.

COUNTIES.	Sent to market. Official.	Home consump'n. Estimated.	Total Product.	Grand Total.
Schuylkill	4,252,043	880,000	5,132,043	
Northumberland	1,234,070	170,000	1,404,070	
Columbia	358,741	25,000	383,741	
Dauphin	449,915	30,000	479,915	
Wyoming	10,047,241	1,675,000	11,722,241	
Lehigh	3,243,168	463,000	3,706,168	
Total anthracite	19,585,178	3,243,000	22,828,178	22,828,178

SEMI-BITUMINOUS.—GROSS TONS.

MINES.	Tons produced.	Total.	
Fall Brook Coal Company, Blossburg	312,466	991,057	
Morris Run Coal Company, Blossburg	357,384		
Blossburg Coal Company, Blossburg	321,207		
McIntyre Coal Company, Ralston	212,462	212,462	
Towanda Coal Company, Towanda	252,329	337,644	
Fall Creek Coal Company, Towanda	85,315		
Total Northern Pennsylvania	1,541,163		
Snow Shoe, Centre county	95,257	1,057,539	
Clearfield county	612,036		
Broad Top, Huntingdon county	350,246		
Total semi-bituminous	2,598,702	2,598,702	2,598,702

BITUMINOUS.—GROSS TONS.

LOCALITIES.	Tons produced.	
Johnstown, used in ironworks, etc. (estimated)	250,000	
Allegheny Mountain region, Pennsylvania Railroad	220,409	
West Pennsylvania Railroad	259,340	
Southwest Pennsylvania Railroad	255,355	
Westmoreland gas coal	878,944	
Pittsburgh gas coal	685,611	
Philadelphia and Erie Railroad	81,742	
Allegheny Valley Railroad	436,650	
Erie and Pittsburgh Railroad (block coal)	529,496	
Lawrence Railroad	132,118	
Newcastle and Beaver Railroad	315,044	
Jamestown and Franklin Railroad	111,169	
Little Sawmill Run Railroad	159,057	
Pittsburgh and Castle Shannon Railroad	125,109	
Pittsburgh and Connellsville Railroad	846,374	
Pittsburgh, West Virginia and Charleston Railroad	2,000	
Pittsburgh, Cincinnati and St. Louis Railroad	447,855	
Shenango and Allegheny Railroad	99,091	
Wheeling, Pittsburgh and Baltimore Railroad	3,733	
Monongahela Navigation	2,157,583	
Used by railroads, not in above	600,000	
Mined on rivers and in country pits, not in above	500,000	
Total bituminous coal	9,096,680	9,096,680
Total production of Pennsylvania in 1873		34,523,560